Aspect CONSULTING

November 8, 2019

VIA ELECTRONIC MAIL

Ms. Kathryn Cerise
U.S. Environmental Protection Agency Region 10
1200 Sixth Avenue, Suite 155, ECL Mail Code 122
Seattle, WA 98101
quendallcomments@epa.gov

Re: Comments on EPA's Draft Proposed Plan for the Quendall Terminals Site

On behalf of our client, Quendall Terminals, we are providing written comments on the Quendall Terminals Superfund Site Operable Unit 1 (OU1) Proposed Plan and Operable Unit 2 (OU2) Proposed Plan. These Proposed Plans identify a Site remedy that is far more costly, time consuming, and uncertain than other equally protective cleanup alternatives. In numerous documents submitted to Region 10 and listed below and attached, we have previously expressed concerns with the technical assumptions and application of EPA policy that Region 10 has applied in the Site remedy selection process:

- Proposed Preferred Remedy at the Quendall Terminals Site. Technical Memorandum to Lynda Priddy, EPA, March 14, 2014 (Attachment A).
- Quendall Terminals Site Preferred Remedy. Memorandum to US EPA National Remedy Review Board, April 24, 2014 (Attachment B).
- EPA Comments on the Draft Final Feasibility Study. Letter to Lynda Priddy, EPA, October 30, 2014 (Attachment C).
- Preliminary Response to EPA Comments on the Draft Final Feasibility Study. Letter to Lynda Priddy, EPA, November 14, 2014 (Attachment D).
- Review Comments and Responses, Draft Final Feasibility Study, November 6, 2015 (Attachment E).
- Quendall Terminals – Remedy Selection. Letter to Mr. James Wolford, EPA, March 19, 2018 (Attachment F).
- Quendall Terminals – STAR Pilot Study and Proposed Plan. Letter to Cami Grandinetti, EPA, dated November 14, 2018 (Attachment G).

We are disappointed that the concerns raised in these documents have not been addressed by the Proposed Plans. In fact, the Proposed Plans include additional problematic elements and assumptions, with limited or no technical basis provided, that are inconsistent with many of the conclusions approved by Region 10 in the Feasibility Study (FS: Aspect and Arcadis, 2016) and provided by EPA's contractor in the STAR Pre-Design Evaluation Report (Savron, 2018).

Our overarching comments on the Proposed Plans are as follows:

- **EPA's objective of groundwater restoration is infeasible.** The assumption that the OU1 Proposed Plan can restore groundwater is inconsistent with the modeling and other technical analysis in the FS and leads to an overly aggressive remedy that is costly and time consuming but still does not achieve this objective.

- **STAR will not achieve EPA's objectives.** The OU1 remedy relies on this unproven technology that will not meet EPA's treatment objectives and is costly, resource intensive, and time consuming with no tangible benefit.

- **The OU1 Proposed Plan greatly underestimates the time and cost of including STAR.** The cost estimate is based on flawed technical and implementation assumptions that are inconsistent with the pilot testing results and heterogeneity of the subsurface conditions and contaminant distribution at the site. It also lacks appropriate contingencies, and the timeframe does not include time for mobilization, installation, and decommissioning or the likely application of in situ stabilization (ISS) in areas that do not achieve adequate treatment.

- **Not all DNAPL-impacted materials require active treatment.** EPA's plan to treat or remove all dense non-aqueous phase liquid (DNAPL)-impacted materials overestimates the actual risks posed by these materials. Much of the DNAPL at the site can be reliably contained while providing less impact to the community and workers than extensive removal or treatment.

- **There are better alternatives.** There are many alternative approaches that would be protective, meet EPA threshold requirements, and reduce impacts to the community. A more cost-effective alternative would allow the cleanup to proceed in a timely manner so that the Site can be redeveloped and the property put back into productive use in accordance with Superfund Task Force objectives.

Additional details and specific comments regarding these issues are provided below.

EPA's objective of groundwater restoration is infeasible. The ability of potential remedies to restore groundwater was exhaustively evaluated in the Groundwater Restoration Potential Technical Memorandum (Aspect and AnchorQEA, 2011) and in the FS (Aspect and Arcadis, 2016). None of the remedies are predicted to restore groundwater across the Site to drinking water levels in less than 100 years. In finalizing the FS, EPA acknowledged that the most aggressive alternatives – FS Alternatives 7, 8, 9, and 10 -- would reduce the groundwater plume footprint but would not completely restore groundwater (Attachment E). For example, Section 7.9.2 of the FS states, regarding Alternative 7:

> *"One hundred years after remedial construction completion for Alternative 7, the groundwater volume exceeding MCLs in the aggregate was predicted to decrease by*

> *roughly 79 percent relative to the No Action alternative… Alternative 7 would satisfy the threshold criterion for compliance with ARARs, with the exception of meeting MCLs everywhere in groundwater. If meeting MCLs in groundwater is deemed technically impracticable, EPA may consider granting a TI waiver. Groundwater modeling predicts that the MCLs for benzene, benzo(a)pyrene, and arsenic will not be met throughout the plume 100 years after remedial construction completion."*

EPA's Proposed Plan for OU1 ignores this conclusion and predicts groundwater restoration in 25 to 30 years, stating misleadingly in Section 9, Preferred Alternative, that:

> *".....aggressive treatment of the significant DNAPL sources is expected to immediately and substantially reduce contaminant concentrations and allow for achievement of PRGs in groundwater in a reasonable restoration timeframe (25 to 30 years)".*

Despite this unrealistic premise, the Proposed Plan acknowledges that PRGs will not be achieve by including a contingency for evaluating even more remedial actions should groundwater restoration not be achieved.

The OU1 Proposed Plan dismisses Alternative 2 through 6 because they do not restore groundwater; yet neither will the selected remedy. EPA acknowledged this in the FS and yet it has somehow come to a different conclusion in order to justify the selection of a highly aggressive and cost-prohibitive remedy. We recommend that source control, not groundwater restoration, is the appropriate remedial action objective given the findings of the FS that groundwater restoration is not attainable.

STAR will not meet EPA's treatment objectives. The OU1 Proposed Plan selects an experimental technology (STAR) that has not been implemented at the scale of the Site. The STAR pilot study did not achieve EPA's remedial objectives for contaminant reduction (see Attachment G). Furthermore, STAR has not been demonstrated at any site to restore groundwater and is unlikely to given the residual concentrations of leachable contaminants measured during the STAR pilot study (Attachment G). Based on the results of the pilot study and EPA's objectives for cleanup, it is highly likely that the areas treated by STAR would also be solidified later and, even then, would not achieve EPA's objective of restoring groundwater.

The OU1 Proposed Plan greatly underestimates the time and cost of including STAR. The estimated cost and timeframe of the remedy, when applied as proposed by EPA, is not realistic. The conceptual implementation plan for treating 63 percent of DNAPL using STAR is inconsistent with the pilot testing results. The STAR cost estimate is highly uncertain because:

(1) It is sensitive to radius of treatment[1] and the radius of treatment assumed was not confirmed during the pilot test.

(2) It failed to consider the multiple layers of DNAPL that will require a significant number of additional ignition points (see Attachment G)[2].

In addition, the cost estimate provided in the proposed plan does not include adequate contingencies. Although EPA's alternative cost assumptions (Appendix B of the OU1 Proposed Plan) indicate the STAR costs include contingencies, the detailed breakdown of the STAR cost (Table B-3) does not include any contingencies. Rather, the STAR estimate assumes a very optimistic basis for cost estimating considering the STAR-specific uncertainties identified in the STAR Pre-Design Evaluation Report (e.g., variability of contaminant concentrations and need for multi-level injection points). For instance, Table B-3 uses a STAR treatment area of 101,495 square feet, approximately 25 percent of the full-scale treatment approach in the STAR Pre-Design Evaluation Report, which assumed a treatment area of 420,865 square feet.

In addition to uncertainties in STAR applicability, there are more general uncertainties (e.g., the delineation of DNAPL occurrences and the total soil volume requiring treatment) that require characterization during pre-design or design studies. In the FS cost estimate, an overall contingency was added to each technology to account for these uncertainties, varying between 25 percent and 35 percent depending on the technology. If a 30 percent contingency were included (which was included for ISS), this would add $6 million (M) to the cost estimate. Given the uncertainty in the STAR cost and the high potential that STAR-treated soil will need to be solidified to meet EPA's objectives, a much higher contingency is warranted further increasing the cost estimate.

We noted that EPA's cost estimate for ISS in the Proposed Plan was much higher than in the FS, supposedly for additional odor controls, although no backup for the assumption was provided. This adjustment added $22M to the remedy cost for Alternative 7. However, ISS has often been implemented in similar settings with no special odor control without causing unacceptable vapor impacts. Even if odor control were required, the cost for such controls (e.g., contained, temporary structures with air collection and treatment) would be much lower than EPA estimates (approximately $5M for Alternative 7, rather than the $22M EPA included). If a more reasonable cost estimate for ISS were applied and a reasonable contingency included, Alternative 7A would be significantly more costly than Alternative 7 – approximately $23M more.

[1] As noted in our November 14, 2018 letter (Attachment G), if the radius of influence were 5 feet rather than the 7 feet assumed by EPA, the number of injection points required for treatment would nearly double.

[2] For instance, the STAR Pre-Design Evaluation Report states *"with the more extensive layering and thicker impacted zone in the May Creek area, it is anticipated that multiple ignition points may be required to treat the entire impacted depth interval in this area of the Site"* (Section 6.2) and *"The pre-characterization will also identify multiple IP depths at a given location in areas where distinct layers of impacts are present (i.e., additional IPs required resulting in increased costs)"* (Section 8.1.3.)

Furthermore, EPA estimated an implementation time—including design—of five years, which is not realistic. It is expected to take several years just to complete the necessary design studies to delineate DNAPL occurrences and define the soil volume requiring treatment. EPA indicates that the STAR operating period would be two years but additional time would be needed to install, test, and decommission the equipment and injection points. STAR and ISS would need to be implemented in sequence, not in parallel, because the application of ISS would depend on the ultimate effectiveness and extent of STAR. In a best-case scenario, in which STAR is implemented in parallel with ISS and no retreatment is needed, the upland remedy would take approximately 7.4 years3. As noted above, it is highly likely that more STAR injection points would be needed and/or areas treated by STAR would need re-treatment by ISS to achieve EPA's objectives. Considering these factors, we estimate that the OU1 Proposed Plan would take at least eight to nine years to implement.

Not all DNAPL-impacted materials require active treatment. Region 10 has broadly defined principal threat waste (PTW) as all creosote- and coal tar-impacted materials, regardless of their potential mobility and risk of exposure, and has included in the Proposed Plan active treatment of all PTW. This is inconsistent with EPA policy and application at other sites[4] (see Attachment F) and leads to a much more aggressive remedy than is warranted. Most DNAPL at the Site has low mobility and can easily and safely be contained in place. In fact, more aggressive techniques—such as ISS under the OU1 Proposed Plan or the extensive dredging called for by the OU2 Proposed Plan—will result in more significant impacts to the community and the natural environment than if these materials were contained**.** Not only will active treatment increase exposure to otherwise isolated materials, active treatment will not fully eliminate contamination due to leaching from solidified soil (see Attachment D), untreated residuals from STAR (see Attachment G), and dredging residuals (see Attachments A and D). Furthermore, odors generated during dredging removal are much more difficult to manage than during ISS. DNAPL that is inaccessible, thin, and immobile represent a greater risk during treatment than if these were contained onsite.

There are better alternatives. As described above, FS Alternatives 2 through 6 are viable alternatives that should be considered in the Proposed Plan. The FS acknowledged this in Section 8.1.3: *"Alternatives 2 through 10 satisfy the overall protection of human health and the environment criterion, and would meet all ARARs if a TI waiver is granted for COCs in groundwater that do not achieve MCLs. Therefore, Alternatives 2 through 10 are carried forward in the Balancing Criteria comparison."* We have highlighted in previous correspondence (see Attachments A and B) that Alternative 4A is more cost-effective and provides a better balance of Superfund selection criteria than Alternative 7. This is still true when compared with Alternatives 7A and D proposed by EPA.

We also note that since the preparation of the FS, advances in ISS have included application of that technology in sediments. We recommend that in addition to reducing the scope of dredging in the

---

[3] This assumes 2.5 years for design (per Alternative 7 in the FS), at least 3 years to implement STAR (including one year for mobilization, installation, shakedown, decommissioning, and demobilization, and 2 years of operation), and 1.9 years to implement ISS (based on the production rate assumed in the FS),
[4] For example, in the 2019 ROD Amendment for the Wyckoff Eagle Harbor Superfund Site, only 65% of DNAPL-impacted materials are targeted for treatment by ISS.

OU2 Proposed Plan, EPA should consider applying ISS in the nearshore area (contiguous with the ISS treatment area in the upland) to reduce the cost and odor impacts associated with dredging.

The costs and uncertainties associated with the Proposed Plans make development infeasible. It is highly likely that the costs will increase above EPA's estimate of $106M because of the inclusion of STAR. Further, including a contingency for additional remedial actions if groundwater is not restored in 30 years makes future costs unpredictable and site redevelopment untenable.

We ask that EPA delay any further action and engage with the potentially responsible parties (PRPs) to explore their willingness to implement a pre-remedial design study to address some of the issues raised in this letter and develop performance criteria to refine remedial alternatives and to better define remediation costs. Only with some additional certainty may it be possible to proceed with cleanup and redevelopment of the Site.

We welcome the opportunity to discuss these comments further with you.

Sincerely,

Tim Flynn, LHG
President and Principal Hydrogeologist
tflynn@aspectconsulting.com

cc: Robert Cugini
Georgia Baxter

References

Aspect and Anchor QEA 2011. Draft Evaluation of Groundwater Restoration Potential Technical Memorandum. May 13, 2011.

Aspect and Arcadis 2016. Feasibility Study, Quendall Terminals Site. December 2016.

Savron 2018. Self-sustaining Treatment for Active Remediation (STAR) Pre-Design Evaluation (PDE) Report. October 18, 2018.

Attachments

- Proposed Preferred Remedy at the Quendall Terminals Site. Technical Memorandum to Lynda Priddy, EPA, March 14, 2014 (Attachment A)
- Quendall Terminals Site Preferred Remedy. Memorandum to US EPA National Remedy Review Board, April 24, 2014 (Attachment B)
- EPA Comments on the Draft Final Feasibility Study. Letter to Lynda Priddy, EPA, October 30, 2014 (Attachment C)
- Preliminary Response to EPA Comments on the Draft Final Feasibility Study. Letter to Lynda Priddy, EPA, November 14, 2014 (Attachment D)
- Review Comments and Responses, Draft Final Feasibility Study, November 6, 2015 (Attachment E)
- Quendall Terminals – Remedy Selection. Letter to Mr. James Wolford, EPA, March 19, 2018 (Attachment F)
- Quendall Terminals – STAR Pilot Study and Proposed Plan. Letter to Cami Grandinetti, EPA, dated November 14, 2018 (Attachment G)

V:\020027 QuendallTerminals\Nov 2019 Response Letter to EPA Proposed Plan\Proposed Plan - Shortcut.lnk.docx

ATTACHMENT A

Proposed Preferred Remedy at the Quendall Terminals Site. Technical Memorandum to Lynda Priddy, EPA, March 14, 2014

Aspect CONSULTING

TECHNICAL MEMORANDUM

Project No.: 020027

March 14, 2014

To:	Lynda Priddy, U.S. EPA
cc:	Robert Cugini, RueAnn Thomas, Lynn Manolopoulos, and Jim Hanken
From:	Jeremy Porter and Tim Flynn, Aspect Consulting Barry Kellems, Integral Consulting
Re:	**Proposed Preferred Remedy at the Quendall Terminals Site** Renton, Washington

Executive Summary

Introduction

Executive Summary Table of Contents

Introduction……………1

Description of the Preferred Remedy……..2

Remedy Selection Criteria………………...3

Conclusion…………….8

The Respondents recently submitted the Draft Final Feasibility Study (FS; Aspect and Arcadis 2013) for the Quendall Terminals Site (Site) to the U.S. Environmental Protection Agency (EPA). In accordance with EPA's April 11, 2013 letter and comments, the FS analyzed remedial alternatives selected by EPA but did not recommend a preferred remedy. EPA will select a preferred remedy, which will be documented in a Proposed Plan and, following public comment, in the Record of Decision (ROD). This memorandum presents our recommendation for the preferred Site remedy, based upon rationale consistent with the National Contingency Plan (NCP) evaluation criteria and EPA guidance for remedy selection.

The Site is located on the southeastern shore of Lake Washington in Renton, Washington. Historical releases of contaminants, primarily coal tar and its distillates (including creosote), by ownership prior to the Respondents, have resulted in an extensive distribution of contaminated soil, groundwater, and sediment over an approximately 51-acre area. Coal tar and creosote as dense, non-aqueous phase liquid (DNAPL) have been observed in subsurface soils in the upland and lakebed sediments to depths of up to 34 feet over an approximately 9.7 acre area. Most DNAPL is located within discrete layers or thin lenses that underlie the Site within the heterogeneous alluvial deposits of the May Creek delta. The Site is located in a former industrial area and is currently vacant. The property is slated for mixed-use commercial development following cleanup. The adjoining property to the south has been redeveloped for residential use and the property immediately to the north has been redeveloped for commercial use (Seattle Seahawks training facility).

The FS describes and evaluates 10 site-wide remedial alternatives that provide a range of types and levels of treatment and containment of Site source materials and contaminated media. A key finding of the detailed evaluation in the FS is that none of the FS alternatives, even those that include treatment or removal of all source materials, are predicted to achieve federal Maximum

Contaminant Levels (MCLs) in groundwater everywhere on the Site, which is required under the Safe Drinking Water Act (SDWA), a Site Applicable or Relevant and Appropriate Requirement (ARAR). The FS analysis, which is summarized in this memorandum and formed the basis for developing the preferred remedy, demonstrates the trade-offs in the NCP balancing criteria (extent of treatment, the long-term effectiveness, and the short-term impacts and cost) for varying levels of source materials treatment.

The final cleanup action that is selected does not necessarily need to be one of the FS alternatives. The FS provides sufficient information and analysis to allow individual remedial components to be assembled into a site-wide remedy that is different from the range of site-wide remedial alternatives presented in the FS. Based on the FS results of the detailed analysis contained in the FS, the Respondents have identified a preferred remedy that combines components of several FS alternatives. The preferred remedy complies with the NCP statutory requirements and exhibits the best results using the NCP balancing criteria by employing a combination of treatment, containment, and institutional controls appropriate for the specific Site conditions, consistent with EPA guidance for remedy selection (EPA 1990).

Description of the Preferred Remedy

The preferred remedy is a combination of elements from FS Alternatives 3 and 5 that best satisfy the balance of NCP evaluation criteria by removing or treating source materials (i.e., DNAPL-impacted materials) that represent the highest long-term Site risk while minimizing the short-term impacts and implementability and high cost concerns associated with dredging or excavating large quantities of source materials that represents relatively lower long-term Site risk.

The preferred remedy includes the following:

- Treatment, via *in situ* solidification, of source materials in the Quendall Pond-Uplands (QP-U) DNAPL Area;
- Treatment, via *in situ* solidification, of deep source materials in the Railroad and Former May Creek (MC) Channel DNAPL Areas;
- Removal and treatment of mobile DNAPL near the shoreline using DNAPL collection trenches;
- Treatment of shallow groundwater along the shoreline using a permeable reactive barrier (PRB);
- Removal of sediment source materials followed by placement of a reactive residuals cover in the T-Dock (TD) DNAPL Area;
- Enhanced natural recovery of offshore sediments exceeding the background threshold value outside source materials areas;
- Containment of contaminated sediments using a combination of reactive caps, engineered sand caps, and enhanced natural recovery;
- Containment of contaminated soils using an upland cap to prevent contact with contaminated materials; and

- Institutional controls and long-term monitoring to confirm remedy effectiveness and ensure continued protectiveness.

Remedial components are illustrated on Figure ES-1. The preferred remedy would treat or remove approximately 50,000 cubic yards of impacted soil and sediment, comprising approximately 26 percent of the total DNAPL estimated to be at the Site. The remainder of Site DNAPL is present in dispersed seams and, to a large extent, in thin layers within highly stratified soil, or deeper beneath lake sediments. This remaining Site DNAPL cannot be removed or treated without also removing or treating substantial volumes of relatively clean overburden soils or sediments (resulting in increased costs and extended construction durations and impacts). This remaining Site DNAPL can be reliably contained and does not represent a significant future risk to human health and the environment due to its location on the Site (e.g., distance from the lake or other receptor) and/or low mobility (e.g., highly weathered and/or migration-limited by low permeability layers).

Remedy Selection Criteria

Consistent with the NCP, the Remedy must meet the threshold criteria and provide the best balance of trade-offs with respect to the balancing and modifying criteria. The Remedy must satisfy the following statutory requirements (Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121): 1) be protective of public health and the environment; 2) comply with ARARs, unless a waiver is justified; 3) be cost-effective; 4) utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable; and 5) satisfy the preference for treatment as a principal element, or explain why the preference for treatment will not be met. The NCP (40 CFR 300.430(a)(1)(iii)) outlines the expectations EPA must consider when developing appropriate remedial alternatives, which include treatment of principal threats, wherever practicable, the use of engineering controls (such as containment) for waste that poses a relatively low long-term threat or where treatment is impracticable, and restoration of groundwater to its highest beneficial use, wherever practicable, within a timeframe that is reasonable given the circumstances of the Site.

A summary of how the preferred remedy satisfies the criteria for remedy selection identified above is presented below, followed by a more detailed discussion in the main text.

In regards to the requirement to achieve groundwater restoration to the extent practicable[1], the NCP (40 CFR 300.430(a)(1)(iii)(D)) states : “the use of institutional controls shall not substitute for active response measures (e.g., treatment *and/or containment* of source material, restoration of ground waters to their beneficial uses) as the sole remedy unless such active measures are determined not to be practicable, *based on the balancing of trade-offs among alternatives that is conducted during the selection of remedy* [emphasis added].”

Similarly, EPA guidance (The Role of Cost in the Superfund Process, EPA 1996) describes how the NCP requirement to use permanent solutions or alternative treatment technologies to the maximum extent practicable is evaluated as part of the balancing criteria. “Advantages and disadvantages of

[1] Note that the evaluation of groundwater restoration to the extent practicable, which depends on the balance of trade-offs between remedial alternatives, is different from the evaluation of technical impracticability that forms the basis for warranting an ARAR waiver. Restoration of groundwater to achieve MCLs at the Site is determined to be technically impracticable based on the findings of the detailed evaluation of alternatives contained in the FS evaluation, as described below under Compliance with ARARs.

alternatives that satisfy the threshold criteria are balanced using the five balancing criteria, and the two modifying criteria (if there is enough information to consider these latter criteria in advance of the formal public comment process). This balancing determines which option represents the remedy that utilizes 'permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable' (MEP) for that site (40 CFR 300.430(f)(1)(ii)(E))."

As stated above, the ability of the preferred remedy to achieve the NCP preference for treatment and expectations for groundwater restoration to the extent practicable depends on the comparative analysis of the preferred remedy relative to other remedial alternatives evaluated in the FS (Aspect and Arcadis 2013). This comparative analysis, including achievement of NCP threshold, balancing, and modifying criteria; restoration of groundwater; treatment of principal threats; and cost-effectiveness is described below.

Compliance with Threshold Criteria

All remedies must satisfy NCP threshold criteria by protecting human health and the environment and complying with ARARs. The preferred remedy satisfies these criteria as described below.

Protectiveness. As with FS Alternatives 2 through 10, the preferred remedy is protective in the long-term and achieves preliminary remediation goals (PRGs) or effectively controls exposure to Site media exceeding PRGs. The preferred remedy achieves protectiveness through a combination of removal and/or treatment of source materials posing the highest long-term risk, and containment of source materials that pose a low long-term risk and can be reliably contained. The preferred remedy also includes institutional controls and long-term monitoring to ensure future performance of the remedy.

Compliance with ARARs. The preferred remedy complies with all ARARs except the SDWA. None of the FS alternatives fully complies with the SDWA, which requires that groundwater be restored to MCLs throughout the Site. Groundwater concentrations of three constituents (arsenic, benzene, and benzo(a)pyrene) are projected to exceed MCLs into the foreseeable future following implementation of the preferred remedy or any of the FS alternatives. Therefore, a technical impracticability determination will be required for any alternative chosen, including the preferred remedy, due to the nature of the contamination and complexity of subsurface Site conditions. However, the preferred remedy reduces the plume extent by treating DNAPL representing the primary source of contamination to deep groundwater. While further reduction in shallower groundwater contamination is technically feasible, doing so would not allow Site groundwater to be put back into beneficial use due to the presence of contaminated groundwater remaining on the Site and on adjacent properties, where remedial actions included covenants restricting groundwater use. Additional treatment would result in greater short-term impacts (e.g., risk of water quality impacts during removal from sediments) and significantly higher cost compared to the marginal benefit of further reducing the plume extent. Additional discussion of this issue is provided below under Restoration of Groundwater.

Balancing Criteria

When evaluating the preferred remedy and the full range of FS alternatives using the balancing criteria, the preferred remedy exhibits the best results, as described in Table ES-1 and summarized below:

- The remedy achieves a **moderate** level of **long-term effectiveness and permanence** by treating or removing materials representing the greatest threat of future releases or exposure (including shallow DNAPL-impacted sediments and potentially mobile DNAPL near the shoreline), treating contaminated groundwater through a combination of a groundwater treatment wall to address shallow groundwater and targeted treatment of deep DNAPL-impacted soil to address deep groundwater, and implementing reliable containment measures that are consistent with future Site uses. These containment measures include engineered caps, reactive caps, and DNAPL collection trenches.

- The remedy achieves a **low** level of **reduction of toxicity, mobility, or volume through treatment** by treating an estimated 19 percent of Site DNAPL (an additional 7 percent of Site DNAPL is removed and disposed of off-site, but is not included in this quantity). However, treatment is applied to DNAPL-impacted materials exhibiting the highest long-term risk.

- The remedy achieves a **high** level of **short-term effectiveness** by focusing treatment and removal actions on areas of highest risk and applying *in situ* treatment methods (*in situ* solidification) where possible. This approach minimizes construction duration and potential impacts that can occur from releases to air or water during construction, particularly during removal actions.

- The remedy achieves a **high** level of **implementability** by using proven technologies and applying them on an easily-implemented scale (i.e., focused removal and treatment efforts).

The preferred remedy is projected to cost approximately $34 million (M; $29M capital and $5M operations and maintenance [O&M]), approximately $8M more than FS Alternative 2, which relies primarily on containment. However, the preferred remedy is significantly less costly than FS alternatives that include treatment or removal of lower-level threat source materials.

Table ES-2 provides a summary of the preferred remedy ranking relative to FS alternatives. A total “balancing score” was developed by assigning a numerical value (1, 2, or 3)[2] for low, medium, and high ratings, respectively. The preferred remedy and FS Alternative 7 (solidification or removal of all DNAPL-impacted materials) have the highest balancing scores (before cost). However, the preferred remedy is less than half the cost ($34M for the preferred remedy versus $80M for FS Alternative 7). Therefore, the preferred remedy exhibits the best result when considering all the NCP balancing criteria.

State and Community Acceptance

The preferred remedy is consistent with state requirements under the Washington State Model Toxics Control Act (MTCA) by being protective of human health and the environment and by providing permanent solutions to the extent practicable (based on an evaluation that includes weighing the cost of the remedy relative to benefits). The preferred remedy is consistent with the final remedial actions at the adjoining properties (J.H. Baxter & Company Site [now the Seattle Seahawks training facility] to the north and the Barbee Mill Site [now Conner Homes] to the south) because their final remedial actions included a combination of removal, treatment, and containment

[2] A numerical value of “0” was assigned to the No Action alternative for criteria which were not addressed at all.

components. Both of these sites have long-term institutional controls in place to prevent exposure to groundwater contamination that will be present into the foreseeable future.

The preferred remedy effectively protects human health and the environment while minimizing activities potentially disruptive to the local community, which includes residential homes and the Seattle Seahawks training facility immediately adjacent to the Site. Given the adjacent site uses, the preferred remedy is likely to be significantly preferred over alternatives involving extended, intensive construction such as FS Alternative 7, which has the same overall rating for NCP balancing criteria as the preferred remedy.

Restoration of Groundwater

The preferred remedy reduces groundwater contamination by treating DNAPL acting as a source to deep groundwater contamination and a groundwater treatment wall treats shallow groundwater before it discharges to Lake Washington. Although treatment of additional DNAPL-impacted soils may incrementally reduce the volume of contaminated groundwater, none of the FS alternatives is predicted to completely restore Site groundwater. Because of the dispersed nature of contamination, further significant reductions in the groundwater plume would only be achieved through treatment of significantly larger volumes of soil. Furthermore, because of subsurface heterogeneities, the feasibility of fully identifying and treating all DNAPL contributing to Site groundwater contamination is questionable. Based on the comparison of the preferred remedy with other FS alternatives, additional treatment to effect groundwater restoration has a minimal benefit but severe negative effects on construction duration, short-term impacts, and cost.

The preferred remedy achieves groundwater restoration to the extent practicable, based on consideration of the trade-offs identified in the comparative analysis of the FS remedial alternatives. Site groundwater is unlikely to be used as a current or future drinking water supply because complete restoration of groundwater is not technically feasible due to the nature of contamination and complex subsurface Site conditions. Furthermore, the Site is bordered by state cleanup sites with residual groundwater contamination and accompanying deed restrictions. Intended future Site use is for mixed-use commercial development. A City of Renton ordinance prohibits the installation and use of water supply wells at the Site and surrounding area. The preferred remedy significantly reduces the extent of contaminated groundwater, and the negative trade-offs (e.g., short-term impacts, community impacts due to extended construction duration, and substantially higher cost) of more extensive treatment or removal outweigh the benefits of further incremental reductions in the groundwater plume.

Treatment of Principal Threats

Consistent with EPA guidance on principal threat and low-level threat wastes (EPA 1991), source materials (e.g., DNAPL) may be categorized as either principal threat or low-level threat based on their toxicity, mobility, and reliability of containment. Although most DNAPL-impacted materials at the Site exhibit relatively high toxicity, these materials often occur in relatively thin seams with low mobility (i.e., below residual saturation or stratigraphically trapped within low-permeability layers). Institutional and engineering controls can effectively prevent exposure and provide reliable long-term containment under the anticipated future land use. For purposes of informing remedy selection, DNAPL-impacted soil and sediment (i.e., source materials) are categorized as either principal threat source materials or low-level threat source materials based on the reliability of containment and the potential risk of future exposure.

The preferred remedy treats or removes principal threat source materials representing the highest risk of future release or exposure, including DNAPL-impacted shallow sediments and potentially mobile DNAPL near the shoreline. The preferred remedy also treats DNAPL-impacted soils contributing to deep groundwater contamination, and treats groundwater near the shoreline using a groundwater treatment wall. Additional treatment is achieved through treatment-oriented containment measures such as DNAPL collection trenches and reactive sediment caps.

One area of principal threat source materials, the QP-S DNAPL Area in nearshore sediments, would not be removed or treated because doing so would potentially result in significantly greater short-term impacts (e.g., water quality impacts to the lake) and higher costs without increasing long-term effectiveness. Instead, this area would be addressed through robust containment measures, including a reactive or amended sand cap and solidification of adjacent upland DNAPL-impacted soil, which would address any potential future contaminant migration. Based on the balancing criteria evaluation, treatment of additional materials including the QP-S DNAPL Area would result in significantly greater short-term impacts and higher costs without a corresponding improvement in reliability or protectiveness. Therefore, the preferred remedy provides treatment of principal threat source materials to the extent practicable.

Cost-Effectiveness

A remedial alternative is cost-effective if its costs are proportional to its overall effectiveness (40 CFR 300430(f)(1)(ii)(D)). Consistent with EPA guidance (EPA 1990), overall effectiveness of a remedial alternative is determined by evaluating three of the five balancing criteria, specifically:

- Long-term effectiveness and permanence;
- Reduction in toxicity, mobility, and volume through treatment; and
- Short-term effectiveness.

Figure ES-2 provides a comparison of the cost-effectiveness of the preferred remedy compared to FS alternatives. To measure cost-effectiveness, the numeric values assigned to the NCP balancing criteria were used to calculate an “overall effectiveness score,” which is the sum of the first three balancing criteria values. A “cost-effectiveness quotient” was calculated by dividing the overall effectiveness score by the estimated present worth cost for each alternative. The higher the cost-effectiveness quotient, the more cost-effective the alternative. As shown on Figure ES-2, the preferred remedy and FS Alternative 2 are the most cost-effective alternatives. Alternatives 4, 5 and 6 would have equal or less overall effectiveness compared to the preferred remedy but would also have increased cost. Alternatives 7, 8, 9, and 10 would have slightly greater effectiveness than the preferred remedy but would also have substantially higher costs associated with much more extensive removal and/or treatment.

Conclusion

The preferred remedy described above should be selected as the final remedy because it:

- Is protective of human health and the environment;
- Provides the best balance of trade-offs amongst the NCP balancing criteria when compared to other potential remedies;
- Permanently treats or removes source materials representing the greatest risk of future exposure and implements containment and groundwater treatment technologies where source materials can be reliably contained and managed over the long-term; and
- Is cost-effective.

The Site would qualify for an ARAR waiver because none of the FS alternatives is predicted to achieve complete groundwater restoration. The preferred remedy includes treatment of deep source materials to reduce the extent of groundwater contamination. Additional incremental reduction in the groundwater plume extent through treatment of low-level threat source materials does not provide a tangible benefit that outweighs the significant increase in short-term impacts and costs. Therefore, the preferred remedy would restore groundwater to the maximum extent practicable.

Tables

Table ES-1 – Summary Evaluation of Remedial Alternatives with Preferred Remedy

Table ES-2 – Comparative Rating of Remedial Alternatives with Preferred Remedy

Figures

Figure ES-1 – Preferred Remedy – Remedy Components

Figure ES-2 – Cost-Effectiveness of FS Alternatives and Preferred Remedy

Table ES-1 - Summary Evaluation of Remedial Alternatives with Preferred Remedy

Quendall Terminals
Renton, Washington

Remedial Alternative		NCP Threshold Criteria		NCP Balancing Criteria						
		Protective of Human Health and the Environment?	Complies with all ARARs?	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Present Worth Cost ($ Millions)		
								Capital	OM&M	Total
1	**No Action (Baseline for Comparison)**	**No.** No measures to reduce risk or prevent inadvertent exposure/mobilization of contaminants.	Does not comply with ARARs.	**Low.** No measures to reduce risk or prevent inadvertent exposure/mobilization of contaminants.	**Low.** No treatment provided.	**Moderate.** No action implemented. RAOs not achieved in foreseeable future.	**High.** Requires no action.	0	0	0
2	**Containment**	**Yes.** Reliance on engineering controls, institutional controls, and monitoring to achieve protectiveness.	Complies with all ARARs except groundwater MCLs under the SDWA. Minimal reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Low.** Achieves human health and environmental RAOs but relies on containment measures, which have a risk of failure. Requires long-term monitoring to assess remedy performance and maintain controls as needed.	**Low.** No treatment provided.	**High.** Construction actions are of relatively short duration and would result in limited impacts to workers, community, and the environment. Time to achieve RAOs (design and construction duration) estimated to be approximately 2 years.	**High.** No anticipated challenges in coordinating with appropriate agencies, obtaining materials or constructing components.	18	7.6	26
3	**Containment with Targeted PTM Solidification (RR and MC DNAPL Areas)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Reduces potential migration and improves reliability compared to Alternative 2 through treatment of source materials and installation of DNAPL collection trenches and groundwater treatment PRB near shoreline.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Low.** Similar to Alternative 2, but provides targeted treatment to reduce the extent of groundwater contamination and reduce the potential for DNAPL and contaminated groundwater to migrate from uplands to lake.	**Low.** An estimated 9 percent of DNAPL is treated. Modest reductions in groundwater volume and contaminant flux are achieved through source materials and groundwater treatment.	**High.** Similar to Alternative 2, with slightly greater impacts (including construction traffic, noise, and air emissions) due to *in situ* solidification of deep upland source materials and DNAPL collection trench/PRB construction. Time to achieve RAOs estimated to be approximately 3 years.	**High.** Similar to Alternative 2, except that *in situ* solidification will require bench and/or pilot testing.	22	9.2	31
Preferred Remedy	**Containment with Targeted Source Materials Solidification (RR, MC, and QP-U DNAPL Areas) and Removal (TD DNAPL Area)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Reduces potential migration and improves reliability compared to Alternative 3 through removal of source materials in the TD DNAPL Area and treatment of source materials in the QP-U DNAPL Area.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Medium.** Actively addresses source materials presenting the most significant risk for re-exposure (i.e., removes shallow sediments and treats potentially mobile DNAPL near the shoreline).	**Low.** An estimated 19 percent of DNAPL is treated. Modest reductions in groundwater volume and contaminant flux are achieved through source materials and groundwater treatment.	**High.** Increased short-term impacts compared to Alternatives 2 and 3 due to air and water quality impacts from dredging DNAPL-impacted sediments; however, impacts will be minimized through use of hydraulic dredging. Time to achieve RAOs is estimated to be in the range of 3 to 4 years.	**High.** Similar to Alternative 3, except that dredging of DNAPL impacted sediments will require additional agency coordination and monitoring to address potential for contaminant releases.	29	4.9	34
4	**Containment with Targeted PTM Removal (TD, QP-S, and QP-U DNAPL Areas)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Further reduces potential future exposures compared to Alternative 3 through removal of source materials in shallow sediments and potentially mobile DNAPL near the shoreline.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Moderate.** Removes source materials presenting the most significant risk for re-exposure (shallow sediments and potentially mobile DNAPL near the shoreline).	**Low.** No reduction in source materials is achieved through treatment (source materials removed under this alternative are disposed of at an off-site facility). Modest reductions in groundwater volume and contaminant flux are achieved similar to Alternative 3.	**Moderate.** Increased short-term impacts compared to Alternatives 2 and 3 due to air and water quality impacts from dredging DNAPL-impacted sediments and overall longer construction duration. Time to achieve RAOs is estimated to be approximately 4 years.	**Moderate.** Dredging of DNAPL-impacted sediments provides technical and administrative challenges to minimizing contaminant releases.	40	4.8	44
5	**Containment with Targeted PTM Solidification (RR, MC, and QP-U DNAPL Areas and ≥ 4-Foot-Thickness) and Removal (TD and QP-S DNAPL Areas)**	**Yes.** Achieves protectiveness through combination of containment and treatment similar to Alternative 4 but provides additional treatment of upland source materials.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Moderate.** Similar to Alternative 4, but provides additional treatment of upland source materials by targeting areas of greater than 4-feet- cumulative DNAPL thickness.	**Moderate.** An estimated 46 percent of source materials is treated. Modest reductions in groundwater volume and contaminant flux are achieved similar to Alternatives 3 and 4.	**Moderate.** Similar to Alternative 4, but with slightly greater short-term impacts (traffic, noise, and air impacts) due to greater volume of upland soil treated. Time to achieve RAOs is estimated to be approximately 4 years.	**Moderate.** Similar to Alternative 4.	42	4.1	47
6	**Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 2-Foot-Thickness) and Removal (TD, QP-S, and QP-U DNAPL Areas)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Achieves protectiveness similar to Alternatives 4 and 5 but provides additional treatment of upland source materials.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Moderate.** Similar to Alternatives 4 and 5, but provides additional treatment of upland source materials by also targeting areas of greater than 2-feet-cumulative DNAPL thickness.	**Moderate.** An estimated 68 percent of source materials are treated. Modest reductions in groundwater volume and contaminant flux are achieved similar to Alternatives 3, 4, and 5.	**Moderate.** Similar to Alternatives 4 and 5, but with greater short-term impacts (traffic, noise, and air impacts) due to greater volume of upland soil treated. Time to achieve RAOs is estimated to be approximately 5 years.	**Moderate.** Similar to Alternatives 4 and 5, but with a slightly longe construction duration.	57	4.1	61
7	**Containment with PTM Solidification (Upland) and Removal (Sediment)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Greatly reduces potential future exposures through removal of all sediment source materials and treatment of all upland source materials.	Complies with all ARARs except groundwater MCLs under the SDWA. Substantial reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**High.** Permanently treas all source materials at the Site via *in situ* solidification of upland source materials and removal of sediment source materials.	**High.** An estimated 85 percent of source materials are treated and significant reductions in groundwater volume and contaminant flux are achieved.	**Low.** Greater short-term impacts (traffic, noise, and air impacts) than Alternative 6 due to longer construction duration, greater volume of soil treated, and greater volume of DNAPL-impacted sediment treated. Time to achieve RAOs is estimated to be approximately 6 years.	**Moderate.** Similar implementation challenges as Alternatives 4 through 6, but with a significantly longer construction duration.	78	2.7	80
8	**Containment with PTM Removal (Upland and Sediment)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Greatly reduces potential future exposures through removal of all source materials.	Complies with all ARARs except groundwater MCLs under the SDWA. Potentially eliminates groundwater exceeding MCLs for benzene. Substantial reduction in volume of groundwater exceeding MCLs for benzo(a)pyrene and arsenic.	**High.** Permanently treats all source materials at the Site via removal/on-site thermal desorption.	**High.** All source materials are treated and significant reductions in groundwater volume and contaminant flux are achieved.	**Low.** Similar to Alternative 7 but greater short-term impacts due to longer construction duration and greater potential for air emissions from excavation, soil handling, and on-site treatment compared to *in situ* solidification. Time to achieve RAOs is estimated to be approximately 7 years.	**Low.** Increased technical challenges compared to Alternative 7 due to complexity of shoring and dewatering for deep excavations and to provide on-site thermal treatment, which is locally uncommon.	137	2.7	140
9	**Containment with Solidification and Removal of Contaminated Soil and Removal of Contaminated Sediment**	**Yes.** Achieves protectiveness primarily through treatment, although containment of low-level contaminated materials is still required.	Complies with all ARARs except groundwater MCLs under the SDWA. Potentially eliminates groundwater exceeding MCLs for benzene. Substantial reduction in volume of groundwater exceeding MCLs for benzo(a)pyrene and arsenic.	**High.** Permanently treas all source materials at the Site via *in situ* solidification of shallow upland source materials and removal/on-site treatment of deep upland source materials of sediment source materials. Also treats significant volumes of low-level contaminated soil and sediment.	**High.** All source materials are treated. Treatment of lower leve contaminated soil and sediment provide additional reductions in contaminated groundwater volume and contaminant flux compared to Alternatives 7 and 8.	**Low.** Increased short-term impacts compared to Alternatives 7 and 8 due to very longer construction duration and very large volumes of soil and sediment treated. Time to achieve RAOs is estimated to be approximately 14 years.	**Low.** Technical and administrative challenges for treatment of soils and sediments on this scale are expected to be significant.	259	2.7	262
10	**Containment with Removal of Contaminated Soil and Sediment**	**Yes.** Achieves protectiveness primarily through treatment, although containment of low-level contaminated materials is still required.	Complies with all ARARs except groundwater MCLs under the SDWA. Potentially eliminates groundwater exceeding MCLs for benzene. Substantial reduction in volume of groundwater exceeding MCLs for benzo(a)pyrene and arsenic.	**High.** Similar to Alternative 9, except all materials treated using removal/on-site thermal desorption, and additional treatment of groundwater provided by long-term pump-and-treat.	**High.** All source materials are treated. Treatment of materials via on-site thermal desorption rather than a combination of *in situ* solidification and thermal desorption provides additional groundwater restoration, including potential removal of benzene exceeding MCLs, compared to Alternative 9.	**Low.** Similar to Alternative 9 but with even greater short-term impacts due to greater extent of removal/on-site thermal treatment instead of *in situ* solidification. Time to achieve RAOs is estimated to be approximately 15 years.	**Low.** Technical challenges are even greater than for Alternative 9 due to the complexities of shoring and dewatering for very deep excavations.	380	29	409

Notes:

Estimated present worth costs are in 2013 dollars, and were calculated using a discount factor of 1.6 percent. The itemized estimates are provided in Appendix D.

ARAR = applicable or relevant and appropriate requirement
DNAPL = dense non-aqueous phase liquid
MC = May Creek
MCL = maximum contaminant level
OM&M = operation, maintenance, and monitoring
PRB = permeable reactive barrier
PTM = principal threat materials; the PTM terminology is retained here when describing FS Remedial Alternative titles to be consistent with the terminology in the FS.
QP-S = Quendall Pond-Sediment
QP-U = Quendall Pond-Upland
RAO = remedial action objective
RR = Railroad
SDWA = Safe Drinking Water Act
TD = T-Dock

Table ES-2 - Comparative Rating of Remedial Alternatives with Preferred Remedy

Quendall Terminals
Renton, Washington

Remedial Alternative		Threshold Criteria: Protective of Human Health and the Environment?	Threshold Criteria: Complies with ARARs	NCP Balancing Criteria: Long-Term Effectiveness and Permanence	NCP Balancing Criteria: Reduction of Toxicity, Mobility, or Volume through Treatment	NCP Balancing Criteria: Short-Term Effectiveness	NCP Balancing Criteria: Implementability	Estimated Present Worth Cost[2] ($M	Numerical Rating (Equal Weighting): Long-Term Effectiveness and Permanence	Numerical Rating: Reduction of Toxicity, Mobility, or Volume through Treatment	Numerical Rating: Short-Term Effectiveness	Numerical Rating: Implementability	**Cumulative NCP Balancing Criteria Rating**
1	No Action (Baseline for Comparison)	No	No	○	○	◑	●	$0	0	0	2	3	**5**
2	Containment	Yes	(Note 1)	○	○	●	●	$26	1	1	3	3	**8**
3	Containment with Targeted PTM Solidification (RR and MC DNAPL Areas)	Yes	(Note 1)	○	○	●	●	$31	1	1	3	3	**8**
Preferred Remedy	Containment with Targeted Source Materials Solidification (RR, MC, and QP-U DNAPL Areas) and Removal (TD DNAPL Area)	Yes	(Note 1)	◑	○	●	●	$34	2	1	3	3	**9**
4	Containment with Targeted PTM Removal (TD, QP-S, and QP-U DNAPL Areas)	Yes	(Note 1)	◑	○	◑	◑	$44	2	1	2	2	**7**
5	Containment with Targeted PTM Solidification (RR, MC, and QP-U DNAPL Areas and ≥ 4-Foot-Thickness) and Removal (TD and QP-S DNAPL Areas)	Yes	(Note 1)	◑	◑	◑	◑	$47	2	2	2	2	**8**
6	Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 2-Foot-Thickness) and Removal (TD, QP-S, and QP-U DNAPL Areas)	Yes	(Note 1)	◑	◑	◑	◑	$61	2	2	2	2	**8**
7	Containment with PTM Solidification (Upland) and Removal (Sediment)	Yes	(Note 1)	●	●	○	◑	$80	3	3	1	2	**9**
8	Containment with PTM Removal (Upland and Sediment)	Yes	(Note 1)	●	●	○	○	$140	3	3	1	1	**8**
9	Containment with Solidification and Removal of Contaminated Soil and Removal of Contaminated Sediment	Yes	(Note 1)	●	●	○	○	$262	3	3	1	1	**8**
10	Containment with Removal of Contaminated Soil and Sediment	Yes	(Note 1)	●	●	○	○	$409	3	3	1	1	**8**

Notes:

[1] Complies with all ARARs except the Safe Drinking Water Act, which requires achievement of groundwater MCLs throughout the Site.

[2] Estimated mid-range present worth costs are in 2013 dollars, and were calculated using a discount factor of 1.6 percent.

PTM = principal threat materials; the PTM terminology is retained here when describing FS Remedial Alternative titles to be consistent with the terminology in the FS.

Legend:

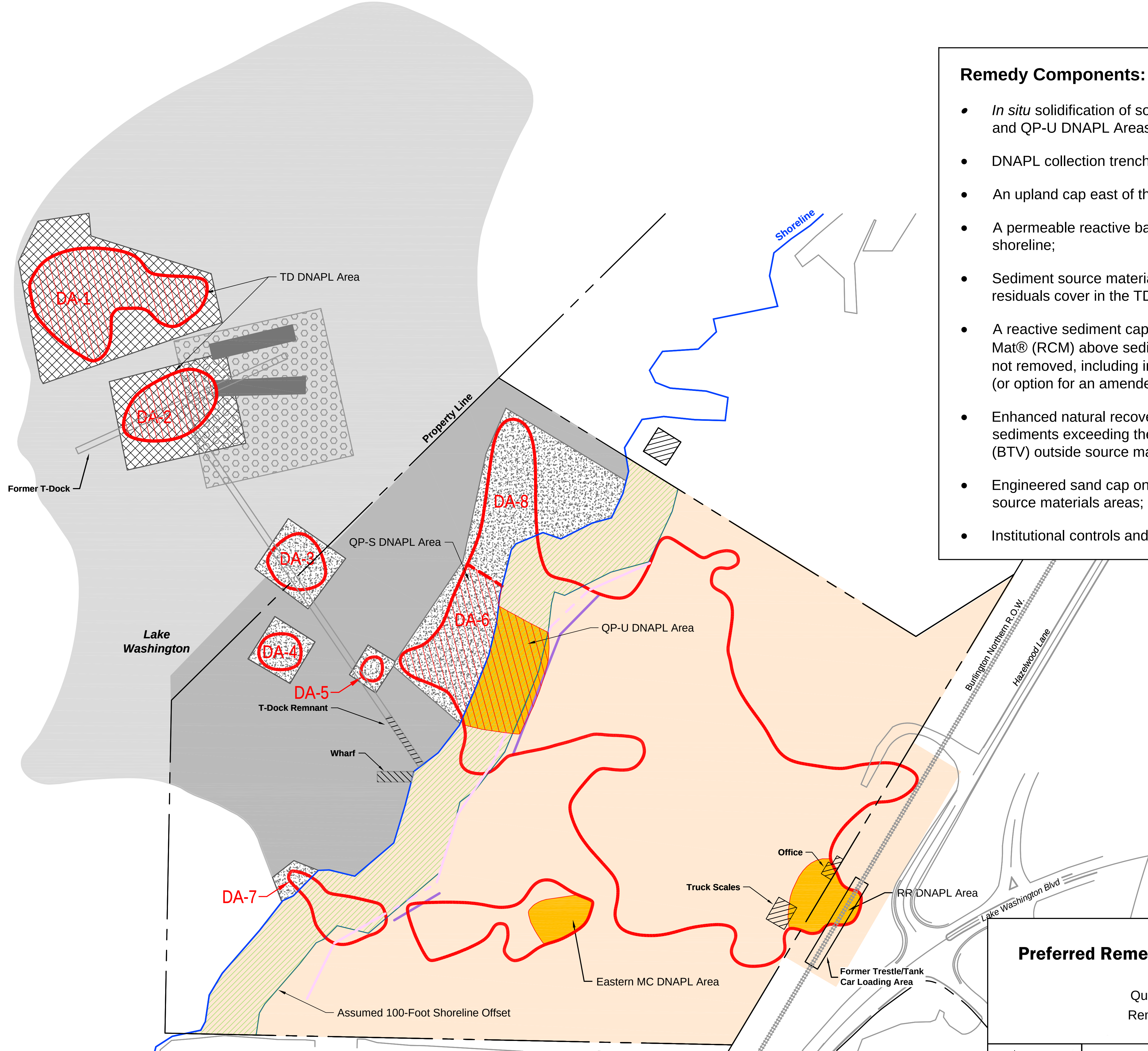
○ (1) The alternative rates low for the criterion.
◑ (2) The alternative rates moderate for the criterion.
● (3) The alternative rates high for the criterion.

Legend

- Existing Structure
- DNR Dry Dock Cap
- DNR Dry Dock Concrete Hulls
- Estimated Extent of DNAPL
- Permeable Treatment Gate
- Impermeable Funnel
- DNAPL Collection Trench
- Habitat Area
- Permeable Cap
- Solidified Soil
- Enhanced Natural Recovery
- Engineered Sand Cap (Note 1)
- Dredge Area
- RCM Reactive Cap (Note 1)
- DA-1 Aquatic DNAPL Area
- Higher-Risk DNAPL Area

Note:

1. The preferred remedy includes sediment removal (not shown on this figure) from the shoreline to approximately 75 feet offshore in areas where engineered sand cap and RCM reactive cap are to be placed, to maintain the existing nearshore area profile.



Remedy Components:

- *In situ* solidification of source materials in the RR, MC, and QP-U DNAPL Areas;
- DNAPL collection trenches along the shoreline;
- An upland cap east of the shoreline;
- A permeable reactive barrier (PRB) along the shoreline;
- Sediment source materials removal with a reactive residuals cover in the TD DNAPL Area;
- A reactive sediment cap composed of a Reactive Core Mat® (RCM) above sediment source materials that are not removed, including in the QP-S DNAPL Area (or option for an amended sand cap);
- Enhanced natural recovery (ENR) of offshore sediments exceeding the background threshold value (BTV) outside source materials areas;
- Engineered sand cap on nearshore sediments outside source materials areas; and
- Institutional controls and monitoring.

DRAFT

Preferred Remedy - Remedy Components

Quendall Terminals
Renton, Washington

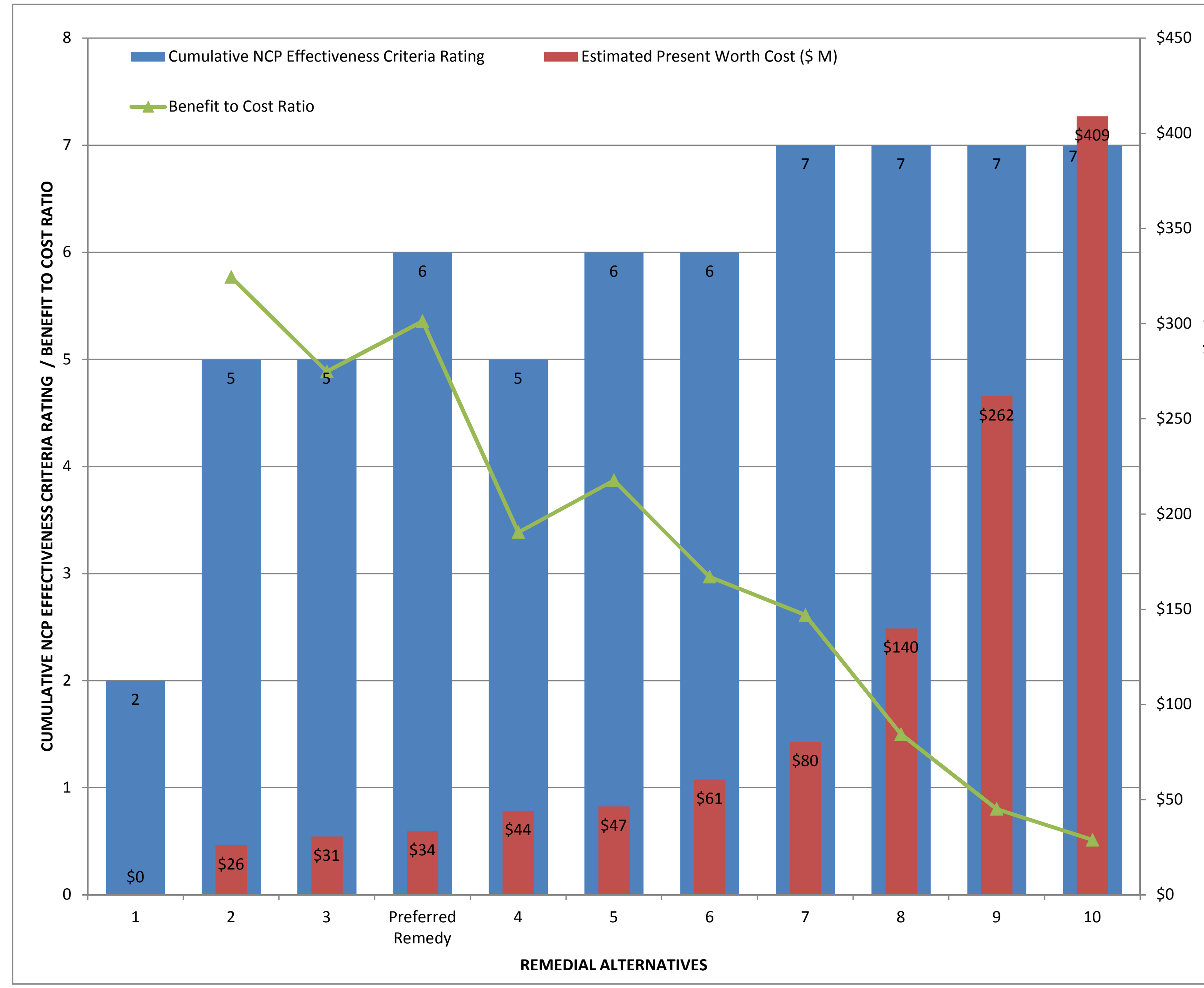
Aspect CONSULTING | ARCADIS

FIRM: ASPECT
DRAWN BY: JJP/ELG/PMB/SCC
FIGURE NO. ES-1

Figure ES-2 - Cost Effectiveness of FS Alternatives and Preferred Remedy

Quendall Terminals
Renton, Washington

Remedial Alternative	Estimated Present Worth Cost ($ M)	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Cumulative NCP Effectiveness Criteria Rating	Benefit to Cost Ratio (NCP Balancing Criteria Rating /Estimated Present Worth Cost)(30 X scaling factor)
1	$0	0	0	2	2	--
2	$26	1	1	3	5	5.77
3	$31	1	1	3	5	4.89
Preferred Remedy	$34	2	1	3	6	5.36
4	$44	2	1	2	5	3.39
5	$47	2	2	2	6	3.87
6	$61	2	2	2	6	2.97
7	$80	3	3	1	7	2.61
8	$140	3	3	1	7	1.50
9	$262	3	3	1	7	0.80
10	$409	3	3	1	7	0.51



DRAFT

Main Text

Introduction

Main Text Table of Contents

Introduction……….……..…...9
Description of the Preferred Remedy………….....10
Comparative Evaluation of the Preferred Remedy..….16
Statutory Requirements for Remedial Actions…........22
Conclusion…........................25
References……….………...26

The Respondents recently submitted the Draft Final Feasibility Study (FS; Aspect and Arcadis 2013) for the Quendall Terminals Site (Site) to the U.S. Environmental Protection Agency (EPA). In accordance with EPA's April 11, 2013 letter and comments, the FS analyzed remedial alternatives selected by EPA but did not recommend a preferred remedy. EPA will select a preferred remedy, which will be documented in a Proposed Plan and, following public comment, in the Record of Decision (ROD). This memorandum presents our recommendation for the preferred Site remedy, based upon rationale consistent with the National Contingency Plan (NCP) evaluation criteria and EPA guidance for remedy selection.

The Site is located on the southeastern shore of Lake Washington in Renton, Washington. Historical releases of contaminants, primarily coal tar and its distillates (including creosote), by ownership prior to the Respondents, have resulted in a broad distribution of contaminated soil, groundwater, and sediment over an approximately 51-acre area. Coal tar and creosote as dense, non-aqueous phase liquid (DNAPL) have been observed over approximately 9.7 acres of the Site up to 34 feet deep. Most DNAPL is located within discrete layers or thin lenses within the heterogeneous alluvial deposits of the May Creek delta. Site areas containing DNAPL are shown on Figure 1. The Site is located in a former industrial area and is currently vacant. The property is slated for mixed-use commercial development following cleanup. The adjoining property to the south has been redeveloped for residential use and the property immediately to the north has been redeveloped for commercial use (Seattle Seahawks training facility).

The FS describes and evaluates 10 remedial alternatives for the Site, but the final cleanup action that is selected does not necessarily need to be one of the FS alternatives. The FS provides sufficient information and analysis to allow the remedial elements to be assembled into a remedy that is not presented in the FS. Based on the results of the detailed analysis contained in the FS, the Respondents have identified a preferred remedy that combines components of several FS alternatives. The preferred remedy complies with the NCP statutory requirements and exhibits the best result using the NCP balancing criteria by employing a combination of treatment, containment, and institutional controls appropriate for the specific Site conditions, consistent with EPA guidance for remedy selection (EPA 1990). This memorandum provides the following:

- A description of the preferred remedy;
- A discussion of how the preferred remedy addresses the principal threats posed by the Site;
- A comparative evaluation of the preferred remedy relative to the FS alternatives using the NCP criteria;
- A discussion of how the preferred remedy achieves the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) statutory requirements; and

- A conclusion discussing the rationale for selecting the preferred remedy.

Description of the Preferred Remedy

The preferred remedy optimizes the balance of NCP evaluation criteria by removing or treating source materials that represents the highest long-term Site risk while minimizing the short-term impacts and implementability concerns associated with dredging or excavating large quantities of dense non-aqueous phase liquid (DNAPL)-impacted materials. The preferred remedy also addresses the NCP statutory requirement that the remedy be protective of human health and the environment and comply with Applicable or Relevant and Appropriate Requirements (ARARs), unless a waiver is justified. Based on the detailed evaluation of groundwater restoration potential as part of the FS, Site groundwater is expected to exceed federal Maximum Contaminant Levels (MCLs) into the foreseeable future even if the most aggressive remedy is chosen. Because there is a high degree of certainty that MCLs cannot be achieved, it is anticipated that EPA will determine that groundwater restoration is technically impracticable and identify a final remedy that will reduce the extent of groundwater exceeding MCLs to the extent practicable. Additional evaluation of the preferred remedy's ability to restore groundwater to the extent practicable is provided under the section on the Comparative Evaluation of the Preferred Remedy.

The preferred remedy then uses containment with a passive treatment component to address source materials with low mobility and in areas that represent lower long-term risk because these materials can be reliably contained at a cost much less than they can be actively treated or removed. The preferred remedy was selected by developing NCP balancing criteria ratings through a comparative analysis of alternatives and their respective remedial components using a rating system based on the NCP balancing criteria, as well as considering cost-effectiveness as defined in EPA guidance (EPA 1996). This analysis supports selection of a preferred remedy that combines remedial components of multiple FS alternatives, prioritizing treatment of higher risk Site source materials and containment of source materials that pose lower long-term risk and can be reliably contained.

Preferred Remedy Components

Components of the preferred remedy are as follows:

- Treatment, via *in situ* solidification, of source materials in the Quendall Pond-Uplands (QP-U) DNAPL Area;
- Treatment, via *in situ* solidification, of deep source materials in the Railroad and Former May Creek (MC) Channel DNAPL Areas;
- Removal and treatment of mobile DNAPL near the shoreline using DNAPL collection trenches;
- Treatment of shallow groundwater along the shoreline using a permeable reactive barrier (PRB);
- Removal of sediment source materials followed by placement of a reactive residuals cover in the T-Dock (TD) DNAPL Area;
- Enhanced natural recovery of offshore sediments exceeding the background threshold value outside source materials areas;

- Containment of contaminated sediments using a combination of Reactive Core Mat® (RCM) caps, engineered sand caps, and enhanced natural recovery;
- Containment of contaminated soils using an upland cap to prevent contact with contaminated materials; and
- Institutional controls and long-term monitoring to confirm remedy effectiveness and ensure continued protectiveness.

Remedial components for the FS alternatives and preferred remedy are listed in Table 1 and a detailed description is provided in Section 6 of the FS. Figure 2 shows the conceptual layout of the preferred remedy in plan view. Figures 3 and 4 show cross-sectional representations of the preferred remedy's upland and offshore components and Table 2 provides estimated construction quantities.

Principal Threats

For the purposes of developing remedial alternatives, the FS defined all Site source materials as Principal Threat Materials (PTMs), including all DNAPL-impacted materials (i.e., oil-coated and oil-wetted soil and sediment). However, the actual risk posed by source materials depends on their location and mobility, as discussed as part of the long-term effectiveness criterion in the FS (see Section 7.1.2.1 of the FS). The actual risk also depends on the anticipated future Site use, as summarized in the Rules of Thumb for Superfund Remedy Selection (EPA 1997): "*Soil contamination that could be considered a principal threat under a residential exposure scenario might be considered a low-level threat under a non-residential exposure scenario*".

Site-specific factors, including the long time period since the release occurred, highly dispersed distribution and relatively low mobility of source materials, heterogeneity of subsurface conditions, and proximity to Lake Washington, result in significant variability in the level of risk posed by different Site source materials. Also, with any DNAPL site, there are inherent uncertainties in the exact distribution and characteristics of DNAPL. Although the Site has been extensively investigated and characterized, some uncertainty still exists, particularly considering the highly heterogeneous nature of the Shallow Alluvium soils. Uncertainties in DNAPL distribution have the greatest effect on the reliability of the remedy in areas closest to the lake, particularly in shallow sediments. Additional characterization in shallow sediments during design will be very important to ensure that removal areas are well defined and that the reactive caps are designed appropriately. In the upland, the level of uncertainty in DNAPL distribution does not reduce the reliability of containment measures. The primary uncertainty is the extent of thin layers, or "stringers", of DNAPL that are discontinuously distributed within the Shallow Alluvium. These stringers do not contain sufficient DNAPL volume to present a significant migration threat even in the event of an extreme (e.g., seismic) event.

Consistent with EPA guidance on principal threat and low-level threat wastes (EPA 1991), source materials (e.g., DNAPL) may be categorized as either principal threat or low-level threat based on their toxicity, mobility, and reliability of containment. Although most DNAPL-impacted materials at the Site exhibit relatively high toxicity, these materials often occur in relatively thin seams with low mobility. Institutional and engineering controls can effectively prevent exposure under the anticipated future land use. For this discussion, DNAPL-impacted soil and sediment (i.e., source materials) are categorized as either principal threat source materials or low-level threat source materials based on the reliability of containment and the potential risk of future exposure.

Principal Threat Source Materials. Principal threat source materials are those materials for which there is a higher potential for a DNAPL release and exposure to unacceptable levels of contaminants following an extreme event. This scenario is most likely in areas containing DNAPL in shallow sediments (e.g., less than 3 feet beneath lake waters), such as in the TD DNAPL Area, as well as in upland areas with DNAPL adjacent to the lake, such as in the QP-U DNAPL Area.

Low-Level Threat Source Materials. Low-level threat source materials include those for which the risk for potential exposure, even in an extreme event, is limited. These include widely dispersed, thin layers of DNAPL that do not represent a migration threat to surface water through free-phase product transport because of their immobility (e.g., below residual saturation), and/or their location (e.g., those present at relatively greater depths). These materials do not represent a migration threat to surface water through groundwater transport, as measured by groundwater, porewater, and/or sediment sampling downgradient of these materials. Institutional controls, including covenants and engineering controls, can effectively and reliably prevent future exposure to DNAPL, particularly given potential future land use and proposed monitoring programs.

Source Materials Affecting Deep Groundwater. Source materials also vary in their relative contribution to groundwater contamination. Areas of deep DNAPL represent more significant sources to groundwater contamination than other impacted areas of the Site. The greatest groundwater plume extent exceeding MCLs is caused by deep DNAPL in the Railroad and Former May Creek Channel DNAPL Areas containing significant concentrations of benzene. Groundwater modeling predicts that treatment of deep DNAPL would significantly shrink the extent of groundwater exceeding MCLs. The preferred remedy targets treatment of the deep DNAPL areas to comply with the Safe Drinking Water Act (SDWA) to the extent practicable.

Site source materials, as presented in the Remedial Investigation (RI; Anchor QEA and Aspect 2012) and FS, are delineated into DNAPL Areas as shown on Figure 1. A detailed description of the characteristics of each DNAPL Area, including depth, chemical composition, thickness, mobility, and effect on groundwater, is presented in Section 4.4 of the RI and Section 4.4.2 of the FS. Characteristics and the relative degree of risk posed by each DNAPL Area is summarized in Table 3 and described below.

Principal Threat Source Materials

Three DNAPL Areas represent a higher risk of future release or exposure, primarily due to their close proximity to Lake Washington and/or the potential for DNAPL to be mobilized during an extreme event. These higher-risk areas are as follows:

- **TD DNAPL Area,** near the former T-Dock, where DNAPL released from surface spills at the dock is located in shallow sediments (less than 3 feet deep);
- **QP-S DNAPL Area,** offshore of Quendall Pond, where DNAPL is present in deeper sediments through subsurface migration from the uplands; and
- **QP-U DNAPL Area,** around Quendall Pond, where potentially mobile DNAPL has been observed in upland soils near the shoreline.

Actions taken to address each area under the preferred remedy and the rationale for those actions are described below.

TD DNAPL Area

Source materials in the TD DNAPL Area will be removed in the preferred remedy. Following dredging, a reactive residuals cover will be placed to manage dredging residuals. The TD DNAPL Area sediments contain near-surface DNAPL deposits that, while currently stable, may be potentially disturbed following an extreme event.

The purpose of targeting this area is to remove the sediments that have the highest potential for DNAPL migration to cause exposure to receptors in Lake Washington.

Dredging of the TD DNAPL Area is also recommended because the shallow, localized distribution of DNAPL in this area makes it feasible to remove these materials using environmental hydraulic dredging, which allows for greater control of re-suspension and releases when compared to mechanical dredging. The potential short-term impacts of dredging this area will be monitored and managed during construction, and these impacts are balanced by the long-term benefit of removing these source materials to avoid releases during an extreme event.

QP-U and QP-S DNAPL Areas

The preferred remedy will treat source materials in the QP-U DNAPL Area by *in situ* solidification and place a reactive sediment cap over the QP-S DNAPL Area.

In the QP-U DNAPL Area, *in situ* solidification is proposed rather than removal/off-site disposal because solidification provides effective treatment at a lower cost and with fewer short-term impacts. Because *in situ* solidification does not require robust shoring and dewatering systems, it poses fewer implementability challenges. In addition, *in situ* solidification is expected to result in fewer air emissions than removal.

Reactive capping is proposed in the QP-S DNAPL Area because it is not technically feasible to solidify these sediments and because removal of this deeper source area would require mechanical dredging within a temporary sheet pile enclosure, which has a higher potential for re-suspension and contaminant releases. Solidification of source materials immediately upland of the QP-S DNAPL Area would immobilize the upgradient “source” of DNAPL and prevent groundwater flow through the QP-U source area, thereby reducing future migration of DNAPL into and groundwater flow through the QP-S DNAPL Area. The treatment of the upgradient source materials increases the long-term effectiveness and improves the reliability of the reactive cap in the QP-S DNAPL Area.

The reactive sediment cap in the QP-S DNAPL Area will consist of an organoclay RCM layer to immobilize (i.e., sorb) DNAPL that could be disturbed during an extreme event. The RCM layer will be overlain by clean sand to provide a bioturbation layer (as included in FS Alternative 3). As an option, a thicker, more robust amended sand cap composed of sand enriched with bulk organoclay (i.e., the “amended sand cap” as included in FS Alternative 2) could be used in lieu of an organoclay RCM layer. The amended sand cap option (see Figure 5), may require adjustments to the future shoreline configuration to ensure no net loss of aquatic habitat. As discussed in the FS, it would be necessary to coordinate with other agencies and the Trustees when designing the amended sand cap. Figure 5 shows the conceptual cross-section layout of the preferred remedy incorporating an amended sand cap.

Low-Level Threat Source Materials

Other DNAPL Areas represent a lower risk of future release or exposure and can be reliably contained under anticipated future site uses, even under potential extreme events. These lower-risk areas are as follows:

- **Railroad DNAPL Area,** located on the eastern side of the Site where products were formerly loaded/unloaded;
- **Former May Creek Channel DNAPL Area,** a former creek channel into which wastes were placed;
- **Other Upland DNAPL Areas,** comprising a fairly broad distribution of relatively thin or immobile DNAPL occurrences; and
- **Other Sediment DNAPL Areas.**

These areas are located away from Lake Washington, or comprise very thin DNAPL layers below residual saturation, such that migration of DNAPL from these areas to surface water is a low risk even in an extreme event. Sediment and porewater sampling downgradient of these areas indicate that migration of contaminants from these areas via groundwater to surface water is a low risk. Containment measures that include treatment (such as DNAPL collection trenches, groundwater treatment walls, and reactive sediment caps) provide further assurance that these materials are reliably contained.

The preferred remedy includes treatment of deep DNAPL that is low-level threat material, to satisfy the NCP requirement for achieving groundwater restoration to the maximum extent practicable[3]. Two of the lower-risk areas, the Railroad DNAPL Area and the eastern portion of the Former May Creek Channel DNAPL Area, include zones of deeper DNAPL occurrences (up to 34 feet), which due to the depth have a notable effect on the vertical groundwater plume extent, particularly in the Deep Aquifer. The FS evaluated a range of alternatives that provided treatment of low-level threat materials to varying extents. Based on the FS evaluation, treatment of deeper DNAPL areas would significantly reduce the extent of contaminated groundwater while incurring relatively limited short-term impacts due to the localized nature of these occurrences. However, direct treatment of other low-level threat source materials, which are broadly distributed across the Site, would not provide significant benefit, and the benefits of additional treatment are outweighed by the short-term impacts (including extended construction duration and potential releases of contaminants to air and water) and higher cost. These areas can be reliably contained using measures that treat groundwater using a treatment wall and removal and treatment of DNAPL using collection trenches.

Actions taken to address each of the lower-risk areas under the preferred remedy and the rationale for those actions are described below.

[3] Note that the evaluation of groundwater restoration to the extent practicable, which depends on the balance of trade-offs between remedial alternatives, is different from the evaluation of technical impracticability that forms the basis for warranting an ARAR waiver. Restoration of groundwater to achieve MCLs at the Site is determined to be technically impracticable based on the findings of the detailed evaluation of alternatives contained in the FS evaluation, as described below under Compliance with ARARs.

Railroad DNAPL Area

The Railroad DNAPL Area is located far (700 feet) from Lake Washington and does not pose a risk of release to the aquatic environment. However this area includes the deepest DNAPL occurrence observed at the Site (33.75 feet deep) and is a source of contamination to the Deeper Aquifer. The preferred remedy includes *in situ* treatment of deep DNAPL in this area to reduce the source of contamination to groundwater. Because of the downward hydraulic gradient in this region of the Site, treatment of deep source materials will reduce the contaminant mass entering the Deep Aquifer and significantly reduce the volume of contaminated Site groundwater. This element of the preferred remedy is designed to comply with the ARARs, as defined under the SDWA, to the extent practicable.

The Railroad DNAPL Area would be solidified *in situ*. Groundwater modeling in the FS predicted that implementing *in situ* solidification or removal in this area would reduce the groundwater plume to a similar degree. Because DNAPL removal in this area would require substantial shoring and dewatering, *in situ* solidification is more implementable and less costly and would result in fewer short-term impacts. Based on the current and anticipated future Site use (including commercial development on the Quendall Property and recreational development on the Railroad Property), exposure to solidified contaminated soils can be reliably controlled through deed restrictions with soil management plans that would be implemented if subsurface disturbance was necessary.

Former May Creek Channel DNAPL Area

Similar to the Railroad DNAPL Area, much of the Former May Creek Channel DNAPL Area is located relatively far from Lake Washington and represents little risk to the aquatic environment. However this area also includes one boring (MC-1) where relatively deep DNAPL (32 feet deep) was observed. While the Deeper Aquifer impacts in this area are much less than in the Railroad DNAPL Area because vertical hydraulic gradients are close to neutral in the Former May Creek Channel DNAPL Area, this deep DNAPL still represents a deep source of contamination to groundwater and therefore will be treated *in situ* under the preferred remedy. Treatment of the deep DNAPL in the area is designed to comply with the ARARs, as defined under the SDWA, to the extent practicable. Based on the current and anticipate future Site use, exposure to contaminated soils in the Former May Creek Channel DNAPL Area can be reliably controlled through deed restrictions with soil management plans that would be implemented if subsurface disturbance was necessary.

Although significant DNAPL migration is unlikely, a DNAPL collection trench along the shoreline will ensure DNAPL will not migrate to the shoreline. West of the proposed collection trench, DNAPL occurrences are contained in a relatively thin layer that pinches out close to the shoreline and does not represent a significant migration risk to surface water for either DNAPL or contaminated groundwater (based on sediment and porewater sampling). A reactive sediment cap above this area provides additional assurance that DNAPL is reliably contained.

Other Upland DNAPL Areas

Other Upland DNAPL Areas generally contain DNAPL that is present in very thin discrete layers or below residual saturation and/or highly weathered where present in greater accumulations. These source materials do not significantly impact groundwater quality below the top of the Deeper Alluvium (Aspect and Arcadis 2013). These areas include former process areas such as the North Sump, where significant thicknesses of DNAPL-impacted soil have been observed. However, based on product recovery testing and groundwater monitoring, the contaminants exhibit significantly lower mobility than in the QP-U DNAPL Area.

A DNAPL collection trench along the shoreline will provide additional assurance that DNAPL does not migrate to the shoreline. A PRB along the shoreline will provide treatment of groundwater contaminated by upland source materials. West of the proposed collection trench and PRB, DNAPL occurrences are contained in relatively thin layers that do not represent a significant migration risk to surface water for either DNAPL or contaminated groundwater.

Other Sediment DNAPL Areas

Other Sediment DNAPL Areas contain DNAPL that is thin-layered and below residual saturation (Aspect and Arcadis 2013). These areas include the area north of the QP-S DNAPL Area, where a thin layer of relatively deep (10 to 15 feet) DNAPL has been observed. This area, which does not impact overlying sediment or porewater quality, would be difficult to remove because of its depth.

These areas also include several small DNAPL areas between the QP-S DNAPL Area and the TD DNAPL Area, and a small area adjacent to the Former May Creek Channel DNAPL Area. As with the QP-S DNAPL Area, this area does not impact overlying sediment or porewater quality. The preferred remedy includes reactive sediment caps above all the Other Sediment DNAPL Areas to provide additional assurance that DNAPL will be reliably contained.

Summary of Treatment Provided by the Preferred Remedy

Approximately 31,800 cubic yards (cy) of soil will be solidified in the QP-U, Railroad, and Former May Creek Channel DNAPL Areas, resulting in treatment of an estimated 73,000 gallons of DNAPL. Approximately 12,200 cy of sediment containing an estimated 33,700 gallons of DNAPL will be removed from the TD DNAPL Area. Additional DNAPL removal, estimated at roughly 8,000 gallons, will result from construction and operation of the collection trenches and construction of the PRB. In total, the preferred remedy will result in treatment or removal of approximately 26 percent of the Site DNAPL (19 percent treated and 7 percent removed), as summarized in Table 4. In addition to direct treatment of the source materials, shallow groundwater contamination will be treated by the PRB along the shoreline, and reactive sediment capping will treat DNAPL should it migrate due to an extreme event.

Comparative Evaluation of the Preferred Remedy

Analysis of the preferred remedy relative to the FS alternatives is provided below and summarized in Table 5. A summary of the comparative rating of the preferred remedy and the FS alternatives is provided in Table 6.

The comparative analysis includes a qualitative rating based on the NCP balancing criteria (other than cost). Alternatives were assigned numerical values (low = 1[4], moderate = 2, high = 3) and summed to provide an “overall rating” for the preferred remedy and each of the FS alternatives (see Table 6). The preferred remedy and FS Alternative 7 have the highest overall rating (9), and the cost of the preferred remedy ($34M) is less than half of FS Alternative 7 ($80M). The preferred remedy

[4] A numerical value of “0” was assigned to the No Action alternative for criteria which were not addressed at all.

provides the best result when considering all the NCP balancing criteria by targeting source materials treatment as follows:

- Treating the majority of principal threat source materials, including DNAPL in shallow sediments in the T-Dock Area and DNAPL along the shoreline in the QP-U DNAPL Area posing a threat to the lake;
- Treating low-level threat source materials driving the extent of the groundwater plume, including deep DNAPL in the Railroad and Former May Creek Channel DNAPL Areas.

Treatment of targeted source materials can be accomplished in a relatively short timeframe while minimizing short-term construction impacts and implementability concerns associated with extensive treatment or removal of large volumes of soil and sediment, including source materials that can be effectively contained.

Evaluation of the preferred remedy relative to the FS alternatives for each of the threshold and NCP evaluation criteria is provided below.

Overall Protection of Human Health and the Environment

As with Alternatives 2 through 10, the preferred remedy meets this threshold criterion by achieving preliminary remediation goals (PRGs) or effectively controlling exposure to Site media containing contamination exceeding PRGs through a combination of removal, treatment, and containment. As described below under long-term effectiveness, the preferred remedy treats source materials posing the greatest risk and contains source materials that can be reliably contained and effectively managed in the long-term with appropriate institutional controls, monitoring and maintenance.

Compliance with ARARs

The preferred remedy meets this threshold criterion for all ARARs except the SDWA. None of the FS alternatives fully complies with the SDWA, which requires that groundwater be restored to MCLs throughout the Site. In the FS, compliance with the SDWA was evaluated using groundwater modeling based on conservative transport parameter assumptions to evaluate on a relative basis the volume of groundwater exceeding MCLs for each chemical of concern (COC) 100 years after the remedy is implemented. Groundwater model results for the preferred remedy and FS alternatives entailing varying degrees and methods of source materials treatment are shown on Figure 6.[5] The modeling results predict the following:

- Treatment of deep source materials results in the greatest reduction in groundwater plume volume exceeding MCLs (an approximately 35 percent reduction compared to the No Action alternative) in proportion to the amount of materials treated.
- Treatment of several other areas of shallower source materials, including those with thicker occurrences in the Former May Creek Channel and North Sump DNAPL Areas (FS Alternatives 5 and 6), provide only marginal additional reductions in plume volume.

---

[5] The FS groundwater model over-predicted the extent of benzene, based on empirical data from Site wells. Groundwater model results for benzene shown on Figure 6 are based on a refined biodegradation half-life estimate that more closely matches empirical data.

- Treatment of all Site source materials (FS Alternatives 7 through 10) provides significant reductions in the benzene plume volume but smaller volume reductions for benzo(a)pyrene and arsenic.

The model results predict that even after extensive treatment or removal of source materials, a significant volume of Site groundwater will continue to exceed MCLs into the foreseeable future.

Although the model predicts significant reductions in benzene plume volume for FS alternatives that include treatment of all source materials (Alternatives 7 through 10), it is likely that the simplified model assumptions result in an *under-prediction* of the plume size for these more aggressive alternatives. The model assumes: 1) 100 percent of the source materials are treated, which is unlikely given the recognized difficulty in fully identifying and treating all DNAPL occurrences at similar sites—particularly within the complex, heterogeneous geology of the Shallow Alluvium; 2) no residuals remain after excavation for alternatives involving removal of DNAPL-containing soils; and 3) homogeneous (i.e., uniform) contaminant transport parameters within each geologic unit, whereas in reality the biodegradation of contaminants and the rate of flushing is likely highly variable and would result in some areas restoring over much longer timeframes than predicted by the model. Sensitivity analyses performed on the FS model indicate that the simplified model assumptions result in under-prediction of the groundwater plume volume and restoration timeframe.

Because there is a high degree of certainty that none of the alternatives will achieve MCLs throughout the Site, a technical impracticability determination will be required for any alternative chosen, including the preferred remedy. The scope of the determination will be based on the restoration potential for the Site and the selected remedy must reduce the volume of contaminated groundwater to the extent practicable. Treatment of deep DNAPL would result in a significant reduction of the groundwater plume exceeding MCLs, including a substantial portion of the Deep Aquifer; however, treatment of shallow DNAPL would result in proportionally less reductions in the groundwater plume. The restoration of the Shallow Aquifer (located in deltaic deposits of heterogeneous disconnected layers of peat, silt, silty sand, and sand) is technically impracticable. As demonstrated in the FS, none of the FS alternatives would achieve MCLs for all constituents. The preferred alternative, through targeted treatment of deep source materials, provides the best balance of trade-offs in reducing the size of the groundwater plume by minimizing short-term impacts and cost. Therefore, the Site would qualify for an ARAR waiver and the preferred remedy would meet this threshold criterion.

It should also be noted that groundwater contamination in the Shallow Aquifer on the two adjacent properties to the north and south of the Site (for which cleanup has been conducted under formal orders with the Washington State Department of Ecology [Ecology]) will be present into the foreseeable future. Because of the groundwater contamination on adjoining properties, it is unlikely that groundwater at the Site could be used for drinking water for the foreseeable future. In addition, water supply wells at the Site and surrounding area are prohibited by City of Renton ordinance. Therefore, restrictive covenants to address Site groundwater contamination would be consistent with anticipated future Site use and the remedies on the adjacent properties.

Long-Term Effectiveness and Permanence

The long-term effectiveness of the preferred remedy is rated moderate. The preferred remedy addresses source materials in shallow sediments and potentially mobile DNAPL near the shoreline by removing source materials in the TD DNAPL Area and solidifying source materials in the QP-U DNAPL Area. The preferred remedy significantly reduces the extent of groundwater contamination by treating deep source materials in the Railroad and Former May Creek Channel DNAPL Areas. The preferred remedy also includes DNAPL collection trenches to prevent DNAPL migration to the lake and groundwater treatment with a PRB to reduce contaminant mass flux to sediments. Source materials in the QP-S DNAPL Area are addressed using a RCM reactive sediment cap; however, DNAPL in this area is located in deeper sediments and presents a lower risk of exposure than source materials in shallow sediment. Furthermore, by solidifying the adjacent upgradient QP-U DNAPL Area, the reliability of the RCM cap is improved by eliminating the potential for DNAPL in the QP-U DNAPL Area to act as an additional source to the QP-S DNAPL Area.

As summarized on Table 5, the preferred remedy provides more reliable controls and less residual risk than Alternatives 2 and 3 through removal or treatment of source materials near Lake Washington. Alternatives that include treatment of greater volumes of upland source materials (Alternatives 5 and 6) do not significantly improve reliability or effectiveness. To achieve substantially greater permanence, all source materials must be treated or removed (Alternatives 7 through 10); however, as discussed below, doing so would require treatment or removal of a substantially larger volume because of the broad distribution of low-level threat source materials.

Reduction of Toxicity, Mobility, or Volume through Treatment

The preferred remedy is rated low for this criterion, partly because the preferred remedy includes removal as well as treatment of source materials (removal and off-site disposal is not included for this criterion). The preferred remedy treats approximately 19 percent of the Site source materials (26 percent of source materials are treated or removed), as discussed above, including treatment of groundwater impacted by source materials using a PRB. Based on the FS groundwater model,[6] the preferred remedy would significantly reduce the size of the groundwater plume by approximately 35 percent, as shown on Figure 6. The preferred remedy would reduce the mass flux of benzene and benzo(a)pyrene at the shoreline by approximately 80 to 90 percent.[7] In addition to direct treatment of source materials, reactive sediment capping and DNAPL collection trenches will control DNAPL mobility through treatment should DNAPL migrate due to an extreme event.

Short-Term Effectiveness

In general, short-term impacts increase with construction duration and the quantities of contaminated materials removed or handled. Alternatives 2 and 3 were ranked high, Alternatives 4 through 6 were ranked moderate, and Alternatives 7 through 10 were ranked low for short-term effectiveness. The preferred remedy is rated high for this criterion as duration is relatively short and the extent of short-term impacts can be addressed through best management and standard construction practices. Construction noise and traffic will provide some impacts but the material quantities and associated truck traffic are relatively modest compared to alternatives that involve greater treatment or removal, particularly Alternatives 7 through 10. Emissions to air during treatment will be minimized by using *in situ* treatment methods in the upland. Removal of source materials along the shoreline and beneath Lake Washington has the potential to mobilize DNAPL

---

[6] Plume volume of benzene is based on the refined half-life assumption described in the Compliance with ARARs section.
[7] Mass flux for the preferred remedy was not modeled directly; however, its performance is expected to be similar to FS Alternative 5 because it contains similar remedial components in the uplands near the shoreline.

and, even with monitoring and mitigation, may result in significant environmental impacts to the aquatic environment and short-term disruption of the aquatic habitat. Alternatives that include removal of these materials have the highest overall potential for environmental impacts and the impacts would be proportional to the scope of source materials disturbed. The preferred remedy minimizes short-term impacts during dredging by using environmental hydraulic dredging to address a relatively focused area of shallow source materials. Under the preferred remedy, source materials that would result in more significant impacts if removed (i.e., the QP-S DNAPL Area) would be addressed through robust containment measures.

When compared to Alternatives 5 through 10, the preferred remedy includes fewer short-term risks (worker hazards, vapor emissions, and water quality impacts) to the surrounding community, workers, and the environment. These fewer short-term risks are because of the more limited dredging program, solidification (rather than removal) of the QP-U DNAPL Area and deep DNAPL in the Railroad and Former May Creek Channel DNAPL Areas, and the shorter construction duration (see Figure 7).

Implementability

In general, implementability decreases with the increased complexity of the alternatives, as summarized in Table 6. The preferred remedy is rated high for this criterion. The preferred remedy presents no unusual construction challenges, construction quantities are relatively modest, and the necessary engineering and construction services are available. The technologies used by the preferred remedy are technologies that have been implemented at other, similar sites and could be implemented at the Site. While reactive caps are innovative, their use is increasing, and there are no market or technical limitations preventing their implementation (EPA 2013).

The most significant implementability challenges for remedial alternatives arise from the technical and administrative complexities associated with deep excavations and extensive dredging of DNAPL-impacted sediments. However, the preferred remedy does not include deep excavations or extensive dredging. The preferred remedy is more implementable than FS Alternatives 4 through 10 because the dredge volume is much less (approximately 15, 000 cy compared to 26,000 cy for Alternatives 4 through 6; 58,000 cy for Alternatives 7 and 8; and 173,000 cy for Alternatives 9 and 10; see Table 2). In addition, the preferred remedy does not require nearshore temporary sheet pile containment and deep sediment excavation. The preferred remedy is also more implementable than FS Alternatives 4, 8, 9, or 10 because it employs *in situ* treatment in the upland rather than removal of upland source materials (which would involve additional technical complexity from shoring and dewatering compared to solidification).

Cost

A detailed cost estimate for the preferred remedy is provided in Table 7, and a summary of its cost relative to the FS alternatives is provided in Table 8.

The total cost of the preferred remedy is estimated to be $34M. The estimated capital cost ($29M) of the preferred remedy is higher than the estimated capital cost of FS Alternative 3 ($22M; refer to Table 8-1 of the FS), due to dredging of the TD DNAPL Area. The estimated Operation, Maintenance, and Monitoring (OM&M) cost ($4.9M) is less than FS Alternative 3 because less maintenance is required for dredging residual covers (versus reactive sediment caps) for the TD DNAPL Area. The total cost is significantly lower than FS Alternative 4 ($44M) because solidification of the QP-U DNAPL Area and reactive capping of the QP-S DNAPL Area is less costly than removal of these same areas. The cost of the preferred alternative is also significantly lower than FS Alternatives 5 through 10 because low-level threat source materials are effectively contained rather than removed or treated.

State and Community Acceptance

The NCP modifying criteria (state and community acceptance) must also be considered before EPA selects a final remedy and these considerations should be reflected in the Proposed Plan (EPA 1996). Important considerations associated with these criteria include the State of Washington's input on compliance with State ARARs and the public's general response, including the local community and area stakeholders, to the alternatives described in the FS report (EPA 1990) and the Proposed Plan.

The preferred remedy complies with Washington State's Model Toxics Control Act (MTCA) by protecting human health and the environment and achieving permanent solutions to the extent practicable, which under Washington Administrative Code (WAC) 173-340-360 (3) requires an analysis of the benefits of a remedy in proportion to its costs. As described in this memorandum, treating additional source materials would not significantly improve the protectiveness of the remedy but would greatly increase the costs.

The preferred remedy is also consistent with the final remedial actions at the adjoining properties (J.H. Baxter & Company Site to the north [now the Seattle Seahawks training facility] and the Barbee Mill Site [now Conner Homes] to the south) that, as indicated above, have been implemented under formal order with Ecology. These final remedial actions included a combination of removal, treatment, and containment components. Both of these sites have long-term institutional controls in place to prevent exposure to groundwater contamination that will be present into the foreseeable future. The long-term presence of groundwater contamination at the adjoining properties will require continued groundwater use restrictions and similar institutional controls, irrespective of the extent of groundwater cleanup afforded by the Site remedy, because of the potential for groundwater removal at the Site to pull contamination from the adjacent properties.

The preferred remedy also minimizes potentially disruptive activities to the local community. Alternatives involving extended, intensive construction (such as FS Alternative 7, which has the same overall rating for NCP balancing criteria as the preferred remedy) are likely to be less preferred by the adjacent residential community and the adjacent Seattle Seahawks training facility due to the resulting noise, traffic and odors. In addition, the preferred remedy includes an option for using an amended sand cap, rather than a RCM, as the reactive cap for the QP-S DNAPL Area located in the nearshore area (see Figure 5). An amended sand cap would provide opportunities to enhance and improve aquatic habitat along the shoreline but as described in the FS (Section 6.3.2.3), the design of an engineered sand cap would need to be done in consultation with other agencies and the Trustees.

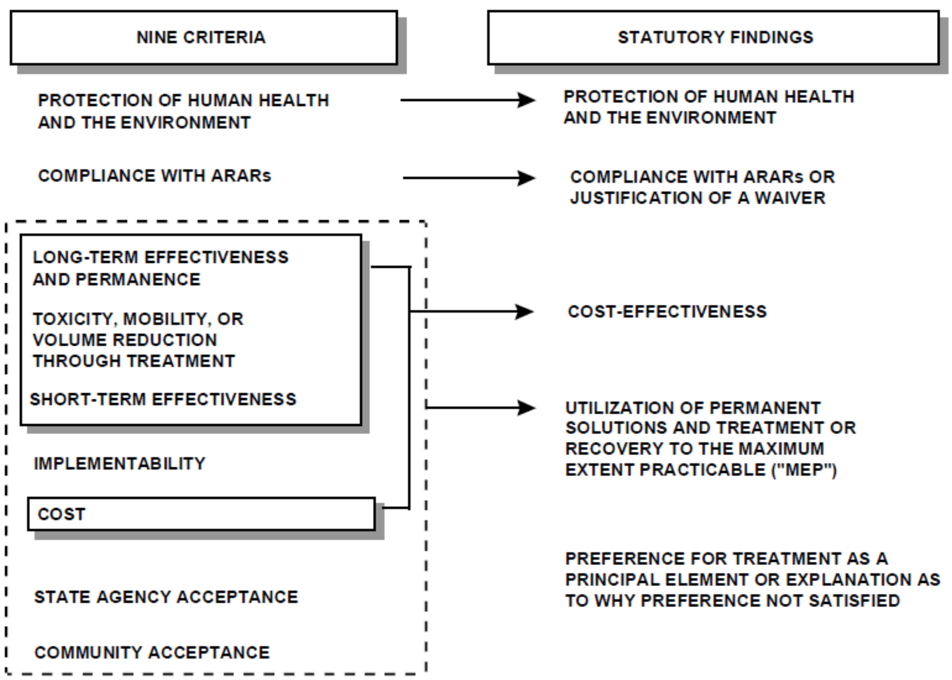
Therefore, consideration of NCP modifying criteria also supports selection of the preferred remedy.

Statutory Requirements for Remedial Actions

As summarized in Section 1.1 of the FS, the statutory requirements for remedial actions that must be addressed in the ROD are as follows (EPA 1988):

- Protect human health and the environment;
- Attain ARARs or provide appropriate grounds for EPA to make a determination that achieving ARARs is technically impracticable;
- Be cost-effective;
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable;[8] and
- Satisfy the preference for treatment to reduce toxicity, mobility, or volume to the extent practicable.

Evaluation of statutory requirements is discussed in EPA guidance (EPA 1990 and 1996). These guidance documents discuss the relationship between the nine criteria and the statutory requirements and are summarized in Figure 8 (EPA 1996, Exhibit 2).



[8] Note that the evaluation of using permanent solutions and providing treatment to the extent practicable, which depends on the balance of trade-offs between remedial alternatives, is different from the evaluation of technical impracticability that forms the basis for warranting an ARAR waiver. Restoration of groundwater to achieve MCLs at the Site is determined to be technically impracticable based on the findings of the detailed evaluation of alternatives contained in the FS evaluation, as described under Compliance with ARARs.

Figure 8. Relationship of the Nine CERCLA Criteria to Statutory Findings (from EPA 1990 and 1996)

The first two statutory requirements are addressed under the threshold criteria for remedial actions. As discussed above, all the FS alternatives and the preferred remedy protect human health and the environment and attain all ARARs, except for achieving SDWA MCLs in groundwater. There is a high degree of certainty that none of the alternatives evaluated in the FS—including the most aggressive option involving complete removal of all source materials (to the extent possible)—can achieve MCLs throughout the Site, which provides grounds for invoking a waiver of this ARAR. When invoking a waiver, EPA must determine what remedial actions must be undertaken to ensure the final remedy is protective of human health and the environment. The appropriate level of source removal and remediation must be evaluated on a site-specific basis, considering the degree of risk reduction and any other potential benefits that would result from potential remedial actions. Based on the analysis provided above, the preferred remedy provides the appropriate degree of risk and groundwater plume reduction at this Site.

To help evaluate the other statutory requirements, the qualitative ratings assigned for each NCP balancing criteria, other than cost, were assigned a numerical value (low = 1, moderate = 2, high = 3) and summed to provide an overall rating for the preferred remedy and each of the FS alternatives. The numeric values and overall ratings are included in Table 6. The preferred remedy and Alternative 7 received the highest overall rating (9).

Evaluation of cost-effectiveness and use of permanent solutions and treatment to the maximum extent practicable are discussed below.

Cost-Effectiveness

EPA's guidance, The Role of Cost in the Superfund Remedy Selection Process (EPA 1996), notes that "*cost is a critical factor in the process of identifying a preferred remedy. In fact, CERCLA and the NCP require that every remedy selected must be cost-effective*" and provides a methodology for evaluating cost-effectiveness (see Exhibit 3, EPA 1996). The guidance states that "*A remedial alternative is cost-effective if its costs are proportional to its overall effectiveness (40 CFR 300430(f)(1)(ii)(D)). Overall effectiveness of a remedial alternative is determined by evaluating the following three of the five balancing criteria: long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. Overall effectiveness is then compared to cost to determine whether the remedy is cost-effective.*"

The above EPA guidance methodology was used to assess the cost-effectiveness of the preferred remedy relative to the FS alternatives. To measure cost-effectiveness, the numeric values assigned to the NCP balancing criteria are used to calculate an "overall effectiveness score," which is the sum of the first three balancing criteria values. Based on traditional cost-effectiveness analysis techniques (Levin and McEwan 2000), a "cost-effectiveness quotient" is calculated by dividing the overall effectiveness score by the estimated present worth cost for each alternative. The higher the cost-effectiveness quotient, the more cost-effective the alternative. Figure 9 presents the overall effectiveness score, cost, and cost-effectiveness quotient for the preferred remedy and the FS alternatives. As shown on Figure 9, the preferred remedy and FS Alternative 2 are the most cost-effective alternatives.

Utilization of Permanent Solutions and Treatment to the Maximum Extent Practicable

The NCP reflects a preference for using treatment to address principal threats posed by a site wherever practicable, and to satisfy the preference for treatment to reduce toxicity, mobility, or volume to the extent practicable. However, "*These expectations are intended primarily to assist in focusing the development of alternatives in the FS…These expectations do not substitute for site-specific balancing of the nine criteria to determine the maximum extent to which treatment can be practicably used*" (EPA 1990).

Also, "*Advantages and disadvantages of alternatives that satisfy the threshold criteria are balanced using the five balancing criteria, and the two modifying criteria (if there is enough information to consider these latter criteria in advance of the formal public comment process). This balancing determines which option represents the remedy that utilizes 'permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable' (MEP) for that site (40 CFR 300.430(f)(1)(ii)(E*))." (EPA 1996)

To evaluate the use of permanent solutions and treatment or recovery to the maximum extent practicable, the overall rating (combined numeric values for the five balancing criteria, excluding cost) of the preferred remedy and the FS alternatives were compared. The preferred remedy and FS Alternative 7 received the highest overall rating (9; see Table 6) but the preferred remedy is less than half the cost of FS Alternative 7 ($34M versus $80M). In addition, the preferred remedy is anticipated to rate higher than FS Alternative 7 in regards to the modifying criteria (state and community acceptance). As discussed above under short-term effectiveness, compared to the preferred remedy, FS Alternative 7 would have a significant impact upon the surrounding community because of its intensive and extended construction period (and associated noise and truck traffic) and greater risks to air and water quality from disturbance and removal of DNAPL-impacted soils and sediments, which will release contaminants and cause short-term impacts that cannot be fully mitigated. Based on this analysis, the preferred remedy best satisfies the NCP requirement to use permanent solutions to the maximum extent practicable.

Conclusion

The preferred remedy described above should be selected as the final remedy because it:

- Is protective of human health and the environment;
- Provides the best balance of trade-offs amongst the NCP balancing criteria when compared to other potential remedies;
- Permanently treats or removes source materials representing the greatest risk of future exposure and implements containment and groundwater treatment technologies where source materials can be reliably contained and managed over the long-term; and
- Is cost-effective.

The Site would qualify for an ARAR waiver because none of the FS alternatives is predicted to achieve complete groundwater restoration. The preferred remedy includes treatment of deep source materials to reduce the extent of groundwater contamination. Additional incremental reduction in the groundwater plume extent through treatment of low-level threat source materials does not provide a tangible benefit that outweighs the significant increase in short-term impacts and costs. Therefore, the preferred remedy would restore groundwater to the maximum extent practicable.

References

Anchor QEA and Aspect Consulting (Aspect), 2012, Final Remedial Investigation Report, Quendall Terminals Site, Renton, Washington, Prepared for the U.S. Environmental Protection Agency, Region 10, on behalf of Altino Properties, Inc. and J.H Baxter & Company, September 2012, Incorporates Revisions Provided by EPA Region 10.

Aspect Consulting, LLC (Aspect) and ARCADIS, Inc. (Arcadis), 2013, Draft Final Feasibility Study, Quendall Terminals Site, Renton, Washington, Prepared for the U.S. Environmental Protection Agency, Region 10, on behalf of Altino Properties, Inc. and J.H Baxter & Company, October 2013, Incorporates Revisions Provided by EPA Region 10.

Levin, H. M. and P. J. McEwan, 2000, Cost-Effectiveness Analysis: Methods and Applications, Second Edition, Sage Publications

U.S. Environmental Protection Agency (EPA), 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, U. S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC, PE89-184626, EPA/540/G-89/004, OSWER Directive 9355.3-01, October 1988.

U.S. Environmental Protection Agency (EPA), 1990, A Guide to Selecting Superfund Remedial Actions, U. S. Environmental Protection Agency, OSWER Directive 9355.0-27FS, April 1990.

U.S. Environmental Protection Agency (EPA), 1991, A Guide to Principal Threat and Low Level Threat Wastes, U. S. Environmental Protection Agency, OSWER Superfund Publication: 9380.3-06FS, November 1991.

U.S. Environmental Protection Agency (EPA), 1996, The Role of Cost in the Superfund Remedy Selection Process, U. S. Environmental Protection Agency, OSWER Directive Publication 9200.3-23FS, September 1996.

U.S. Environmental Protection Agency (EPA), 1997, Rules of Thumb for Superfund Remedy Selection, U. S. Environmental Protection Agency, OSWER Directive Publication 9355.0-69, September 1996.

U.S. Environmental Protection Agency (EPA), 2013, OSWER Directive 9200.2-128FS, Use of Amendments in In-Situ Remediation at Superfund Sediment Site

Tables

Table 1 – Assembly of Technologies and Process Options into Remedial Alternatives with Preferred Remedy

Table 2 – Summary of Remedial Alternative Construction Quantities with Preferred Remedy

Table 3 – DNAPL Areas of Elevated Concern and Proposed Remedial Actions

Table 4 – Estimated Volumes of DNAPL Treated or Removed Under Alternative Remedial Actions with Preferred Remedy

Table 5 – Summary Evaluation of Remedial Alternatives with Preferred Remedy

Table 6 – Comparative Rating of Remedial Alternatives with Preferred Remedy

Table 7 – Preferred Remedy Cost Estimate

Table 8 – Summary of Remedial Alternative Cost Estimates with Preferred Remedy

Figures

Figure 1 – Areas Targeted for Remedial Action

Figure 2 – Preferred Remedy – Remedy Components

Figure 3 – Preferred Remedy – Upland Remedy Components along Cross Section D-D'

Figure 4 – Preferred Remedy – Offshore Remedy Components along Cross Section E-E'

Figure 5 – Preferred Remedy – Offshore Remedy Amended Sand Cap Section

Figure 6 – Projected Restoration in All Aquifers 100 Years After Implementation of Alternative Remedial Actions with Preferred Remedy

Figure 7 – Summary of Estimated Remedy Design and Construction Durations with Preferred Remedy

Figure 8 – Relationship of the Nine CERCLA Criteria to Statutory Findings (embedded)

Figure 9 – Cost-Effectiveness of FS Alternatives and Preferred Remedy

V:\020027 Quendall Terminals\FS Report\Preferred Remedy Letter\Final\Preferred Remedy Memo_031414.docx

Table 1 - Assembly of Technologies and Process Options into Remedial Alternatives with Preferred Remedy

Quendall Terminals
Renton, Washington

	Technology General Response Actions	Remedial Technologies/ Process Options	Alternative 1 No Action	Alternative 2 Containment	Alternative 3 Containment with Targeted PTM Solidification (RR and MC DNAPL Areas)	Preferred Remedy Containment with Targeted Source Materials Solidification (RR, MC, and QP-U Areas) and Removal (TD DNAPL Area)	Alternative 4 Containment with Targeted PTM Removal (TD, QP-S, and QP-U DNAPL Areas)	Alternative 5 Containment with Targeted PTM Solidification (RR, MC, and QP-U DNAPL Areas and ≥ 4-Foot-Thickness) and Removal (TD and QP-S DNAPL Areas)	Alternative 6 Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 2-Foot-Thickness) and Removal (TD, QP-S, and QP-U DNAPL Areas)	Alternative 7 Containment with PTM Solidification (Upland) and Removal (Sediment)	Alternative 8 Containment with PTM Removal (Upland and Sediment)	Alternative 9 Containment with Solidification and Removal of Contaminated Soil and Removal of Contaminated Sediment	Alternative 10 Containment with Removal of Contaminated Soil and Sediment
Upland DNAPL/Soil	Institutional Controls	Deed and Access Restrictions	--	X	X	X	X	X	X	X	X	X	X
	In Situ Containment	Cover or Cap	--	X	X	X	X	X	X	X	X	X	X
	In Situ Treatment	Solidification	--	--	Deep source materials[2]	QP-U DNAPL Area and Deep source materials[2]	--	QP-U DNAPL Area plus shallow source materials >4-foot cumulative thickness[1] and deep source materials[2]	Shallow source materials >2-foot cumulative thickness[1] and deep source materials[2]	All source materials	--	All deep contaminated soil (below approx. 15 feet bgs)	--
	Removal	DNAPL Collection Trenches	--	--	At Former May Creek and Quendall Pond shoreline	At Former May Creek and Quendall Pond shoreline	At Former May Creek and Quendall Pond shoreline	--	--	--	--	--	--
		Excavation	--	--	--	--	QP-U DNAPL Area	--	QP-U DNAPL Area	--	All source materials	All shallow contaminated soil (above approx. 15 feet bgs)	All contaminated soil
	Ex Situ Treatment	On-site Thermal Desorption	--	--	--	--	--	--	--	--			
	Disposal	Off-site Landfill	--	--	--	--	QP-U DNAPL Area	--	QP-U DNAPL Area	--	--	--	--
Aquatic DNAPL/Sediment	Institutional Controls	Deed Restrictions	--	X	X	X	X	X	X	X	X	X	X
	Monitoring	Biological/Physical Recovery	--	X	X	X	X	X	X	X	X	X	X
	Enhanced Natural Recovery (ENR)	Thin-layer Placement	--	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV	Offshore sediments outside source materials areas exceeding BTV
	In Situ Containment	Engineered Sand Cap	--	Nearshore sediments outside source materials areas	Nearshore sediments outside source materials areas	Nearshore sediments outside source materials areas	Nearshore sediments outside source materials areas	Nearshore sediments outside source materials areas	Nearshore sediments outside source materials areas	Nearshore sediments outside source materials areas	Nearshore sediments outside source materials areas	Nearshore sediments outside areas of source materials or MCL exceedances	Nearshore sediments outside areas of source materials or MCL exceedances
	In Situ Treatment	Reactive Sediment Cap	--	All aquatic DNAPL areas[4]	All aquatic DNAPL areas	Aquatic DNAPL areas DA-3 through DA-8	Aquatic DNAPL areas DA-3, DA-4, DA-5, DA-7, and DA-8	Aquatic DNAPL areas DA-3, DA-4, DA-5, DA-7, and DA-8	Aquatic DNAPL areas DA-3, DA-4, DA-5, DA-7, and DA-8	--	--	--	--
		Reactive Residuals Cover	--	--	--	Removal areas to address residuals	Removal areas to address residuals	Removal areas to address residuals	Removal areas to address residuals	Removal areas to address residuals	Removal areas to address residuals	Removal areas to address residuals	Removal areas to address residuals
	Removal[3]	Mechanical Dredging with Sheet Pile Containment	--	--	--	--	QP-S DNAPL Area (DA-6)	QP-S DNAPL Area (DA-6)	QP-S DNAPL Area (DA-6)	Aquatic DNAPL areas DA-5, DA-6, DA-7, and DA-8	Aquatic DNAPL areas DA-5, DA-6, DA-7, and DA-8	Nearshore sediments in areas of source materials or MCL exceedances	Nearshore sediments in areas of source materials or MCL exceedances
		Hydraulic Dredging with Water Quality Controls	--	--	--	TD DNAPL Area (DA-1 and DA-2)	TD DNAPL Area (DA-1 and DA-2)	TD DNAPL Area (DA-1 and DA-2)	TD DNAPL Area (DA-1 and DA-2)	Aquatic DNAPL areas DA-1, DA-2, DA-3, and DA-4	Aquatic DNAPL areas DA-1, DA-2, DA-3, and DA-4	Aquatic DNAPL areas DA-1, DA-2, DA-3, and DA-4	Aquatic DNAPL areas DA-1, DA-2, DA-3, and DA-4
	Ex Situ Treatment	On-site Thermal Desorption	--	--	--	--	--	--	--	--	All removed sediment	All removed sediment	All removed sediment
	Disposal	Off-site Landfill	--	--	--	All removed sediment	All removed sediment	All removed sediment	All removed sediment	All removed sediment	--	--	--
Groundwater	Institutional Controls	Deed Restrictions	--	X	X	X	X	X	X	X	X	X	X
	Monitoring	Groundwater Monitoring	--	X	X	X	X	X	X	X	X	X	X
	In Situ Containment	Slurry Wall Barriers	--	--	Funnel and gate system along most of Site shoreline	Funnel and gate system along most of Site shoreline	Funnel and gate system along most of Site shoreline	Funnel and gate system along most of Site shoreline	Funnel and gate system along most of Site shoreline	--	--	--	--
	In Situ Treatment	Permeable Reactive Barrier	--	--						--	--	--	--
	Removal	Pumping from Vertical Wells	--	--	--	--	--	--	--	--	--	--	Pump and treat groundwater from below excavated areas
	Ex Situ Treatment	On-site Treatment	--	--	--	--	--	--	--	--	--	--	
	Disposal	Undetermined	--	--	--	--	--	--	--	--	--	--	

Notes:

-- Dashes indicate action not included for that alternative.

[1] Cumulative thickness of DNAPL-impacted soil in the top 20 feet of soil column.

[2] Deep source materials refers to the RR DNAPL Area and polygon MC-1 (Former May Creek Channel; refer to Figure 4-6 of the FS).

[3] Process options for dredging are evaluated on a preliminary basis in this FS and will be more fully evaluated during remedial design.

[4] In Alternative 2, the reactive sediment cap configuration in the QP-S DNAPL Area (DA-6) differs from that in the other sediment cap areas. Refer to Section 6.3.2.3 of the FS.

bgs = below ground surface
BTV = background threshold value
DNAPL = dense non-aqueous phase liquid
PTM = principal threat material; the PTM terminology is retained here when describing FS Remedial Alternative titles to be consistent with the terminology in the FS.
QP-U= Quendall Pond-Upland
RR = Railroad

Table 2 - Summary of Remedial Alternative Construction Quantities with Preferred Remedy

Quendall Terminals
Renton, Washington

		Alternative 2	Alternative 3	Preferred Remedy	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Alternative 9	Alternative 10
	Remedial Component	**Containment**	**Containment with Targeted PTM Solidification (RR and MC DNAPL Areas)**	**Containment with Targeted Source Materials Solidification (RR, MC, and QP-U DNAPL Areas) and Removal (TD DNAPL Area)**	**Containment with Targeted PTM Removal (TD, QP-S, and QP-U DNAPL Areas)**	**Containment with Targeted PTM Solidification (RR, MC, and QP-U DNAPL Areas and ≥ 4-Foot-Thickness) and Removal (TD and QP-S DNAPL Areas)**	**Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 2-Foot-Thickness) and Removal (TD, QP-S, and QP-U DNAPL Areas)**	**Containment with PTM Solidification (Upland) and Removal (Sediment)**	**Containment with PTM Removal (Upland and Sediment)**	**Containment with Solidification and Removal of Contaminated Soil and Removal of Contaminated Sediment**	**Containment with Removal of Contaminated Soil and Sediment**
Upland DNAPL/Soil	Soil Cap (acres)	22	22	22	22	22	22	22	22	22	22
	DNAPL Collection Trench (lf)	--	500	500	500	--	--	--	--	--	--
	In Situ Solidification (CY)										
	- DNAPL-impacted soil	--	3,600	5,900	--	17,000	25,100	30,500	--	8,400	--
	- Non-DNAPL-impacted soil	--	13,900	25,900	--	61,900	117,400	210,800	--	354,500	--
	Excavate and On-Site Thermal Desorption (CY)										
	- DNAPL-impacted soil	--	--	--	--	--	--	--	30,500	22,000	30,500
	- Non-DNAPL-impacted soil	--	--	--	--	--	--	--	179,600	320,500	674,900
	Excavate and Landfill Disposal (CY)										
	- DNAPL-impacted soil	--	500	500	2,800	400	2,700	--	--	--	--
	- Non-DNAPL-impacted soil	--	2,400	2,400	12,800	1,700	12,100	--	--	--	--
Aquatic DNAPL/ Sediment[2]	In Situ Remediation in Acres										
	- Enhanced natural recovery	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
	- Engineered sand cap	6.2	6.2	6.2	6.4	6.4	6.4	5.5	5.5	3.9	3.9
	- Reactive cap	4.9	5.7	3.0	2.0	2.0	2.0	--	--	--	--
	- Amended sand cap	0.7	--	--	--	--	--	--	--	--	--
	- Post dredge residuals management cover/backfilling	--	--	2.7	3.5	3.5	3.5	6.4	6.4	8.0	8.0
	Dredge and On-site Thermal Desorption of Sediment (CY)	--	--	--	--	--	--	--	58,300	173,100	173,100
	Dredge and Landfill Disposal of Sediment (CY)	2,800	3,200	14,900	25,900	25,900	25,900	58,300	--	--	--
	Temporary Sheet Pile Enclosure (lf)	--	--	--	700	700	700	1,260	1,260	1,530	1,530
Groundwater	Funnel and Gate PRB (lf)	--	1,100	1,100	1,100	1,100	1,100	--	--	--	--
	Pump and Treat (gpm)	--	--	--	--	--	--	--	--	--	90

Notes:

-- not applicable

[1] Refer to Section 6 and Table 6-3 in the FS for descriptions of the remedial alternatives.

[2] The sediment dredging volumes include dredging to offset for cap placement in the nearshore area.

CY = cubic yards

DNAPL = dense non-aqueous phase liquid

gpm = gallons per minute

lf = linear feet

PRB = permeable reactive barrier

PTM = principal threat materials; the PTM terminology is retained here when describing FS Remedial Alternative titles to be consistent with the terminology in the FS.

Table 3 - DNAPL Areas of Elevated Concern[1] and Proposed Remedial Actions
Quendall Terminals
Renton, Washington

DNAPL Location	Upland[3]				Offshore		
	QP-U DNAPL Area	**Railroad DNAPL Area**	**Former May Creek Channel DNAPL Area**	**Other Upland DNAPL Areas**	**TD DNAPL Area**	**QP-S DNAPL Area**	**Other Sediment DNAPL Areas**
Designation as Principal Threat Source Material [2]?	Yes	No	No	No	Yes	Yes	No
Reason(s) for Designation	Close proximity to Lake Washington and higher potential for a DNAPL release following an extreme (e.g., seismic) event.	Located approximately 700 feet away from Lake Washington	Most DNAPL located far away from Lake Washington and upgradient of future DNAPL collection trenches; DNAPL located close to Lake is in thin seams with low mobility and relatively deep below sediment mudline.	Most DNAPL located far away from Lake Washington and upgradient of future DNAPL collection trenches; DNAPL located close to Lake is in thin seams with low mobility and relatively deep below sediment mudline.	DNAPL in this area is close to lakebed surface; therefore there is potential for exposure and a higher potential for a release following an extreme (e.g., seismic) event.	DNAPL in this area is deeper and further from the lakebed than the DNAPL in the TD Area, but the greater thickness of DNAPL and its proximity to the lake does create potential for a release following an extreme (e.g., seismic) event.	Located in thin seams with low mobility and relatively deep below mudline.
Deep Source of Contamination to Groundwater?	No	Yes; DNAPL observed to nearly 34-foot depth in area of downward hydraulic gradient.	DNAPL observed to 32-foot depth in eastern portion of this area (boring MC-1).	No	No	No	No
Proposed Remedial Action to Address DNAPL Areas of Elevated Concern[1,3]	*In situ* solidification.	*In situ* solidification.	*In situ* solidification in area of deep DNAPL.	--	Removal using environmental hydraulic dredging.	Reactive sediment capping.	Although not considered areas of elevated concern, these areas will also be covered by reactive sediment caps.
Rationale for Proposed Action	*In situ* solidification will effectively immobilize DNAPL and, compared to removal/off-site disposal, is less costly, easier to implement, and will result in fewer short-term impacts.	While *in situ* solidification or removal would reduce the groundwater plume to a similar degree, removal would be more costly and difficult to implement, and would result in more short-term impacts.		--	Dredging of the shallow impacted sediments in this area is highly feasible and will remove 50% of the total sediment DNAPL. Compared to mechanical dredging, environmental hydraulic dredging has relatively less potential for contaminant re-suspension and releases.	Reactive sediment capping will effectively contain DNAPL following an extreme (e.g., seismic) event. *In situ* solidification of sediments is not technically feasible. Removal of these deeper impacted sediments would require mechanical dredging which has more implementability challenges and-term impacts to the community.	These ares contain less than 10% of the total sediment DNAPL and present a relatively low risk, even during an extreme (e.g., seismic) event. Reactive sediment capping will provide additional assurance that a DNAPL release following an extreme (e.g., seismic) event, however unlikely, will be contained .

Notes:

1) For the purposes of this table, DNAPL areas of elevated concern include those designated as principal threat source materials and those which are a deep source of contamination to groundwater.

2) Principal threat source materials refer to DNAPL that has a higher potential for release to Lake Washington following an extreme (e.g., seismic) event.

3) Other remedial actions not specifically called out in this table would also address contamination associated with upland DNAPL in the preferred remedy, including: soil capping to reduce the potential for direct contact and inhalation exposure; DNAPL collection trenches to prevent DNAPL migration to the lake; and groundwater treatment with a PRB to reduce contaminant mass flux to sediments.

DNAPL = dense non-aqueous phase liquid
PRB = permeable reactive barrier
QP-S = Quendall Pond-Sediment
QP-U = Quendall Pond-Upland
TD = T-Dock

Table 4 - Estimated Volumes of DNAPL Treated or Removed Under Alternative Remedial Actions with Preferred Remedy
Quendall Terminals
Renton, Washington

	Alternative 2	Alternative 3	Preferred Remedy	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Alternative 9	Alternative 10
	Containment	Containment with Targeted PTM Solidification (RR and MC DNAPL Areas)	Containment with Targeted Source Materials Solidification (RR, MC, and QP-U DNAPL Areas) and Removal (TD DNAPL Area)	Containment with Targeted PTM Removal (TD, QP-S, and QP-U DNAPL Areas)	Containment with Targeted PTM Solidification (RR, MC, and QP-U DNAPL Areas and ≥ 4-Foot-Thickness) and Removal (TD and QP-S DNAPL Areas)	Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 2-Foot-Thickness) and Removal (TD, QP-S, and QP-U DNAPL Areas)	Containment with PTM Solidification (Upland) and Removal (Sediment)	Containment with PTM Removal (Upland and Sediment)	Containment with Solidification and Removal of Contaminated Soil and Removal of Contaminated Sediment	Containment with Removal of Contaminated Soil and Sediment
Upland DNAPL in Gallons										
Removal via Collection Trench, with Off-site Incineration	--	1,300	1,300	1,300	--	--	--	--	--	--
Removal via Excavation, with Off-site Disposal	--	6,600	6,600	34,900	4,500	32,900	--	--	--	--
Removal via Excavation, with On-site Thermal Desorption	--	--	--	--	--	--	--	377,500	273,100	377,500
Total Upland DNAPL Removed	0	7,900	7,900	36,200	4,500	32,900	0	377,500	273,100	377,500
Total Upland DNAPL Treated (via *In Situ* Solidification)	0	44,700	73,000	0	210,800	311,000	377,500	0	104,400	0
Total Upland DNAPL Treated or Removed										
Gallons	**0**	**52,600**	**80,900**	**36,200**	**215,300**	**343,900**	**377,500**	**377,500**	**377,500**	**377,500**
Percent of Total Upland DNAPL	**0%**	**14%**	**21%**	**10%**	**57%**	**91%**	**100%**(6)	**100%**(6)	**100%**(6)	**100%**(6)
Sediment DNAPL in Gallons										
Removal via Mechanical Dredge[4], with Off-site Disposal	--	--	--	25,900	25,900	25,900	32,200	--	--	--
Removal via Mechanical Dredge[4], with On-site Thermal Desorption	--	--	--	--	--	--	--	32,200	32,200	32,200
Removal via Hydraulic Dredge[5], with Off-site Disposal	--	--	33,700	33,700	33,700	33,700	35,400	--	--	--
Removal via Hydraulic Dredge[5], with On-site Thermal Desorption	--	--	--	--	--	--	--	35,400	35,400	35,400
Total Sediment DNAPL Removed										
Gallons	**0**	**0**	**33,700**	**59,600**	**59,600**	**59,600**	**67,600**	**67,600**	**67,600**	**67,600**
Percent of Total Sediment DNAPL	**0%**	**0%**	**50%**	**88%**	**88%**	**88%**	**100%**(6)	**100%**(6)	**100%**(6)	**100%**(6)
Total DNAPL Treated or Removed (Site-wide)				(Note 3)	(Note 3)	(Note 3)				
Gallons	**0**	**52,600**	**114,600**	**95,800**	**274,900**	**403,500**	**445,100**	**445,100**	**445,100**	**445,100**
Percent of Total	**0%**	**12%**	**26%**	**22%**	**62%**	**91%**	**100%**(6)	**100%**(6)	**100%**(6)	**100%**(6)

Notes:

1) -- Dashes indicate not applicable.

2) DNAPL volumes were estimated using the Thiessen polygon areas shown on Figure 4-6 of the FS. Refer to engineering calculation sheets E-7 through E-15 in Appendix E of the FS for detailed calculations.

3) Partial treatment/removal in this alternative includes treatment/removal of DNAPL with the greatest future exposure risk (i.e., the QP-U, QP-S, and TD DNAPL Areas).

4) Mechanical dredge element primarily targets relatively thick, deep (>3 feet) source materials sediment in the nearshore area.

5) Hydraulic dredge element primarily targets relatively thin, shallow (<3 feet) source materials sediment in the offshore area.

6) One hundred percent removal of DNAPL is the goal in Alternatives 7 through 10; however, complete removal of DNAPL is never achieved in practice.

Abbreviations:

DNAPL = dense non-aqueous phase liquid
MC = May Creek
QP-U = Quendall Pond-Upland
RR = Railroad
PTM = principal threat materials; the PTM terminology is retained here when describing FS Remedial Alternative titles to be consistent with the terminology in the FS.
QP-S = Quendall Pond-Sediment
TD = T-Dock

Table 5 - Summary Evaluation of Remedial Alternatives with Preferred Remedy

Quendall Terminals
Renton, Washington

Remedial Alternative		NCP Threshold Criteria: Protective of Human Health and the Environment?	NCP Threshold Criteria: Complies with all ARARs?	NCP Balancing Criteria: Long-Term Effectiveness and Permanence	NCP Balancing Criteria: Reduction of Toxicity, Mobility, or Volume through Treatment	NCP Balancing Criteria: Short-Term Effectiveness	NCP Balancing Criteria: Implementability	Present Worth Cost ($ Millions): Capital	Present Worth Cost ($ Millions): OM&M	Present Worth Cost ($ Millions): Total
1	**No Action (Baseline for Comparison)**	**No.** No measures to reduce risk or prevent inadvertent exposure/mobilization of contaminants.	Does not comply with ARARs.	**Low.** No measures to reduce risk or prevent inadvertent exposure/mobilization of contaminants.	**Low.** No treatment provided.	**Moderate.** No action implemented. RAOs not achieved in foreseeable future.	**High.** Requires no action.	0	0	0
2	**Containment**	**Yes.** Reliance on engineering controls, institutional controls, and monitoring to achieve protectiveness.	Complies with all ARARs except groundwater MCLs under the SDWA. Minimal reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Low.** Achieves human health and environmental RAOs but relies on containment measures, which have a risk of failure. Requires long-term monitoring to assess remedy performance and maintain controls as needed.	**Low.** No treatment provided.	**High.** Construction actions are of relatively short duration and would result in limited impacts to workers, community, and the environment. Time to achieve RAOs (design and construction duration) estimated to be approximately 2 years.	**High.** No anticipated challenges in coordinating with appropriate agencies, obtaining materials or constructing components.	18	7.6	26
3	**Containment with Targeted PTM Solidification (RR and MC DNAPL Areas)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Reduces potential migration and improves reliability compared to Alternative 2 through treatment of source materials and installation of DNAPL collection trenches and groundwater treatment PRB near shoreline.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Low.** Similar to Alternative 2, but provides targeted treatment to reduce the extent of groundwater contamination and reduce the potential for DNAPL and contaminated groundwater to migrate from uplands to lake.	**Low.** An estimated 9 percent of DNAPL is treated. Modest reductions in groundwater volume and contaminant flux are achieved through source materials and groundwater treatment.	**High.** Similar to Alternative 2, with slightly greater impacts (including construction traffic, noise, and air emissions) due to *in situ* solidification of deep upland source materials and DNAPL collection trench/PRB construction. Time to achieve RAOs estimated to be approximately 3 years.	**High.** Similar to Alternative 2, except that *in situ* solidification will require bench and/or pilot testing.	22	9.2	31
Preferred Remedy	**Containment with Targeted Source Materials Solidification (RR, MC, and QP-U DNAPL Areas) and Removal (TD DNAPL Area)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Reduces potential migration and improves reliability compared to Alternative 3 through removal of source materials in the TD DNAPL Area and treatment of source materials in the QP-U DNAPL Area.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Medium.** Actively addresses source materials presenting the most significant risk for re-exposure (i.e., removes shallow sediments and treats potentially mobile DNAPL near the shoreline).	**Low.** An estimated 19 percent of DNAPL is treated. Modest reductions in groundwater volume and contaminant flux are achieved through source materials and groundwater treatment.	**High.** Increased short-term impacts compared to Alternatives 2 and 3 due to air and water quality impacts from dredging DNAPL-impacted sediments; however, impacts will be minimized through use of hydraulic dredging. Time to achieve RAOs is estimated to be in the range of 3 to 4 years.	**High.** Similar to Alternative 3, except that dredging of DNAPL-impacted sediments will require additional agency coordination and monitoring to address potential for contaminant releases.	29	4.9	34
4	**Containment with Targeted PTM Removal (TD, QP-S, and QP-U DNAPL Areas)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Further reduces potential future exposures compared to Alternative 3 through removal of source materials in shallow sediments and potentially mobile DNAPL near the shoreline.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Moderate.** Removes source materials presenting the most significant risk for re-exposure (shallow sediments and potentially mobile DNAPL near the shoreline).	**Low.** No reduction in source materials is achieved through treatment (source materials removed under this alternative are disposed of at an off-site facility). Modest reductions in groundwater volume and contaminant flux are achieved similar to Alternative 3.	**Moderate.** Increased short-term impacts compared to Alternatives 2 and 3 due to air and water quality impacts from dredging DNAPL-impacted sediments and overall longer construction duration. Time to achieve RAOs is estimated to be approximately 4 years.	**Moderate.** Dredging of DNAPL-impacted sediments provides technical and administrative challenges to minimizing contaminant releases.	40	4.8	44
5	**Containment with Targeted PTM Solidification (RR, MC, and QP-U DNAPL Areas and ≥ 4-Foot-Thickness) and Removal (TD and QP-S DNAPL Areas)**	**Yes.** Achieves protectiveness through combination of containment and treatment similar to Alternative 4 but provides additional treatment of upland source materials.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Moderate.** Similar to Alternative 4, but provides additional treatment of upland source materials by targeting areas of greater than 4-feet- cumulative DNAPL thickness.	**Moderate.** An estimated 46 percent of source materials is treated. Modest reductions in groundwater volume and contaminant flux are achieved similar to Alternatives 3 and 4.	**Moderate.** Similar to Alternative 4, but with slightly greater short-term impacts (traffic, noise, and air impacts) due to greater volume of upland soil treated. Time to achieve RAOs is estimated to be approximately 4 years.	**Moderate.** Similar to Alternative 4.	42	4.1	47
6	**Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 2-Foot-Thickness) and Removal (TD, QP-S, and QP-U DNAPL Areas)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Achieves protectiveness similar to Alternatives 4 and 5 but provides additional treatment of upland source materials.	Complies with all ARARs except groundwater MCLs under the SDWA. Modest reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**Moderate.** Similar to Alternatives 4 and 5, but provides additional treatment of upland source materials by also targeting areas of greater than 2-feet-cumulative DNAPL thickness.	**Moderate.** An estimated 68 percent of source materials are treated. Modest reductions in groundwater volume and contaminant flux are achieved similar to Alternatives 3, 4, and 5.	**Moderate.** Similar to Alternatives 4 and 5, but with greater short-term impacts (traffic, noise, and air impacts) due to greater volume of upland soil treated. Time to achieve RAOs is estimated to be approximately 5 years.	**Moderate.** Similar to Alternatives 4 and 5, but with a slightly longer construction duration.	57	4.1	61
7	**Containment with PTM Solidification (Upland) and Removal (Sediment)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Greatly reduces potential future exposures through removal of all sediment source materials and treatment of all upland source materials.	Complies with all ARARs except groundwater MCLs under the SDWA. Substantial reduction in volume of groundwater exceeding MCLs for benzene, benzo(a)pyrene, and arsenic.	**High.** Permanently treats all source materials at the Site via *in situ* solidification of upland source materials and removal of sediment source materials.	**High.** An estimated 85 percent of source materials are treated and significant reductions in groundwater volume and contaminant flux are achieved.	**Low.** Greater short-term impacts (traffic, noise, and air impacts) than Alternative 6 due to longer construction duration, greater volume of soil treated, and greater volume of DNAPL-impacted sediment treated. Time to achieve RAOs is estimated to be approximately 6 years.	**Moderate.** Similar implementation challenges as Alternatives 4 through 6, but with a significantly longer construction duration.	78	2.7	80
8	**Containment with PTM Removal (Upland and Sediment)**	**Yes.** Achieves protectiveness through combination of containment and treatment. Greatly reduces potential future exposures through removal of all source materials.	Complies with all ARARs except groundwater MCLs under the SDWA. Potentially eliminates groundwater exceeding MCLs for benzene. Substantial reduction in volume of groundwater exceeding MCLs for benzo(a)pyrene and arsenic.	**High.** Permanently treats all source materials at the Site via removal/on-site thermal desorption.	**High.** All source materials are treated and significant reductions in groundwater volume and contaminant flux are achieved.	**Low.** Similar to Alternative 7 but greater short-term impacts due to longer construction duration and greater potential for air emissions from excavation, soil handling, and on-site treatment compared to *in situ* solidification. Time to achieve RAOs is estimated to be approximately 7 years.	**Low.** Increased technical challenges compared to Alternative 7 due to complexity of shoring and dewatering for deep excavations and to provide on-site thermal treatment, which is locally uncommon.	137	2.7	140
9	**Containment with Solidification and Removal of Contaminated Soil and Removal of Contaminated Sediment**	**Yes.** Achieves protectiveness primarily through treatment, although containment of low-level contaminated materials is still required.	Complies with all ARARs except groundwater MCLs under the SDWA. Potentially eliminates groundwater exceeding MCLs for benzene. Substantial reduction in volume of groundwater exceeding MCLs for benzo(a)pyrene and arsenic.	**High.** Permanently treats all source materials at the Site via *in situ* solidification of shallow upland source materials and removal/on-site thermal treatment of deep upland source materials of sediment source materials. Also treats significant volumes of low-level contaminated soil and sediment.	**High.** All source materials are treated. Treatment of lower level contaminated soil and sediment provide additional reductions in contaminated groundwater volume and contaminant flux compared to Alternatives 7 and 8.	**Low.** Increased short-term impacts compared to Alternatives 7 and 8 due to very longer construction duration and very large volumes of soil and sediment treated. Time to achieve RAOs is estimated to be approximately 14 years.	**Low.** Technical and administrative challenges for treatment of soils and sediments on this scale are expected to be significant.	259	2.7	262
10	**Containment with Removal of Contaminated Soil and Sediment**	**Yes.** Achieves protectiveness primarily through treatment, although containment of low-level contaminated materials is still required.	Complies with all ARARs except groundwater MCLs under the SDWA. Potentially eliminates groundwater exceeding MCLs for benzene. Substantial reduction in volume of groundwater exceeding MCLs for benzo(a)pyrene and arsenic.	**High.** Similar to Alternative 9, except all materials treated using removal/on-site thermal desorption, and additional treatment of groundwater provided by long-term pump-and-treat.	**High.** All source materials are treated. Treatment of materials via on-site thermal desorption rather than a combination of *in situ* solidification and thermal desorption provides additional groundwater restoration, including potential removal of benzene exceeding MCLs, compared to Alternative 9.	**Low.** Similar to Alternative 9 but with even greater short-term impacts due to greater extent of removal/on-site thermal treatment instead of *in situ* solidification. Time to achieve RAOs is estimated to be approximately 15 years.	**Low.** Technical challenges are even greater than for Alternative 9 due to the complexities of shoring and dewatering for very deep excavations.	380	29	409

Notes:

Estimated present worth costs are in 2013 dollars, and were calculated using a discount factor of 1.6 percent. The itemized estimates are provided in Appendix D of the FS.

ARAR = applicable or relevant and appropriate requirement
DNAPL = dense non-aqueous phase liquid
MC = May Creek
MCL = maximum contaminant level
OM&M = operation, maintenance, and monitoring
PRB = permeable reactive barrier
PTM = principal threat materials; the PTM terminology is retained here when describing FS Remedial Alternative titles to be consistent with the terminology in the FS.
QP-S = Quendall Pond-Sediment
QP-U = Quendall Pond-Upland
RAO = remedial action objective
RR = Railroad
SDWA = Safe Drinking Water Act
TD = T-Dock

Table 6 - Comparative Rating of Remedial Alternatives with Preferred Remedy

Quendall Terminals
Renton, Washington

	Threshold Criteria		NCP Balancing Criteria					Numerical Rating (Equal Weighting)				
Remedial Alternative	Protective of Human Health and the Environment?	Complies with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Estimated Present Worth Cost[2] ($M	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	**Cumulative NCP Balancing Criteria Rating**
1 No Action (Baseline for Comparison)	No	No	○	○	◑	●	$0	0	0	2	3	**5**
2 Containment	Yes	(Note 1)	○	○	●	●	$26	1	1	3	3	**8**
3 Containment with Targeted PTM Solidification (RR and MC DNAPL Areas)	Yes	(Note 1)	○	○	●	●	$31	1	1	3	3	**8**
Preferred Remedy Containment with Targeted Source Materials Solidification (RR, MC, and QP-U DNAPL Areas) and Removal (TD DNAPL Area)	Yes	(Note 1)	◑	○	●	●	$34	2	1	3	3	**9**
4 Containment with Targeted PTM Removal (TD, QP-S, and QP-U DNAPL Areas)	Yes	(Note 1)	◑	○	◑	◑	$44	2	1	2	2	**7**
5 Containment with Targeted PTM Solidification (RR, MC, and QP-U DNAPL Areas and ≥ 4-Foot-Thickness) and Removal (TD and QP-S DNAPL Areas)	Yes	(Note 1)	◑	◑	◑	◑	$47	2	2	2	2	**8**
6 Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 2-Foot-Thickness) and Removal (TD, QP-S, and QP-U DNAPL Areas)	Yes	(Note 1)	◑	◑	◑	◑	$61	2	2	2	2	**8**
7 Containment with PTM Solidification (Upland) and Removal (Sediment)	Yes	(Note 1)	●	●	○	◑	$80	3	3	1	2	**9**
8 Containment with PTM Removal (Upland and Sediment)	Yes	(Note 1)	●	●	○	○	$140	3	3	1	1	**8**
9 Containment with Solidification and Removal of Contaminated Soil and Removal of Contaminated Sediment	Yes	(Note 1)	●	●	○	○	$262	3	3	1	1	**8**
10 Containment with Removal of Contaminated Soil and Sediment	Yes	(Note 1)	●	●	○	○	$409	3	3	1	1	**8**

Notes:

[1] Complies with all ARARs except the Safe Drinking Water Act, which requires achievement of groundwater MCLs throughout the Site.

[2] Estimated mid-range present worth costs are in 2013 dollars, and were calculated using a discount factor of 1.6 percent.

PTM = principal threat materials; the PTM terminology is retained here when describing FS Remedial Alternative titles to be consistent with the terminology in the FS.

Legend:

○ (1) The alternative rates low for the criterion.
◑ (2) The alternative rates moderate for the criterion.
● (3) The alternative rates high for the criterion.

Table 7 - Preferred Remedy Cost Estimate

Quendall Terminals
Renton, Washington

Site:	Quendall Terminals		
Remedial Action Description:	Alternative	PA	Containment with Targeted Source Materials Solidfication (RR, MC, and QP-U DNAPL Areas) and Removal (TD DNAPL Area)
Cost Estimate Accuracy:	FS Screening Level (+50/-30 percent)		
Key Assumptions and Quantities:	Capping of Upland Soil		
(see Appendix E for calculations)	21.6	acre	total area
	940,896	SF	total area
	133,521	SF	permeable area along shoreline
	14,836	BCY	habitat excavation (
	104,544	BCY	total volume based on 3' cap thickness
	Enhanced Natural Recovery - Sand Material		
	14,300	BCY	total volume
	Engineered Sand Cap		
	15,300	BCY	total sand volume
	2,150	BCY	removal volume for offsetting sand cap
	40,000	SF	area for offsetting sand cap
	RCM Reactive Capping materials		
	128,937	SF	area of RCM
	2,415	BCY	total sand volume
	958	BCY	removal volume for offsetting reactive cap
	Soil/Sediment Density		
	1.6	tons/BCY	soil density
	1.3	tons/BCY	sediment density
	0.7	tons/CY	organoclay density
	Solidification of Upland Source Area Soil		
	31,829	BCY	volume of soil to be solidified
	22,352	BCY	volume of soil at shallow depths to be solidified
	9,476	BCY	volume of deeper soil to be solidified
	Volume of sediment removal		
	12,200	BCY	sediment removal
	14,920	BCY	total sediment removal volume (including for offsetting cap)
	12,200	BCY	hydraulic dredging
	400	BCY	residual cover - organoclay
	1,900	BCY	residual cover - sand
	10,000	BCY	backfill
	Volumes for DNAPL collection trench installation		
	167	BCY	volume classified as hazardous
	759	BCY	volume classified as non-hazardous
	Volumes for PRB installation		
	367	BCY	volume classified as hazardous
	1,670	BCY	volume classified as non-hazardous
	163	ton	amount of PRB media
	44	BCY	cover material
	820	LF	slurry wall length

Item	Quantity	Unit	Unit Cost	Total Cost	Source	Notes
CAPITAL CONSTRUCTION COSTS						
Upland Soil Cap						
Mobilization/Demobilization	1	LS	$ 424,940	$ 424,940	percentage of construction costs	includes temporary facilities for duration of construction
Site Preparation	22	acre	$ 6,900	$ 149,040	Costworks	clearing, grubbing brush and stumps
Geotextile marker layer	104,544	SY	$ 2	$ 158,907	Costworks	non-woven, 120lb tensile strength
Import Fill - Permeable Cap	104,544	BCY	$ 30	$ 3,136,320	project experience	
Compaction	104,544	BCY	$ 5	$ 522,720	project experience	
Habitat Area - excavation	14,836	BCY	$ 6	$ 89,014		
Habitat Area - non-hazardous transport and disposal	23,737	ton	$ 50	$ 1,186,853		
Hydroseeding	14,836	SY	$ 1	$ 8,901	Costworks	includes seed and fertilizer for wetland area
Stormwater collection and detention system	1,500	LF	$ 40	$ 60,000	project experience	media filter drain
Subtotal				*$ 5,736,696*		
Tax	9.5%		$ 5,736,696	$ 544,986		Sales Tax
Contingency	25%		$ 6,281,682	$ 1,570,421		
Total Upland Soil Cap Cost				$ 7,852,103		
Enhanced Natural Recovery						
Mobilization/Demobilization	1	LS	$ 56,512	$ 56,512		
Sand Material	22,880	ton	$ 20	$ 457,600	vendor quote	
Sand Placement	22,880	ton	$ 10	$ 228,800	project experience	ENR placed as one lift
Confirmation of Placement	1	LS	$ 20,000	$ 20,000		
Subtotal				*$ 762,912*		
Tax	9.5%		$ 762,912	$ 72,477		Sales Tax
Contingency	25%		$ 835,389	$ 208,847.16		
Total Enhanced Natural Recovery Cost				$ 1,044,236		
Engineered Sand Cap						
Mobilization/Demobilization	1	LS	$ 71,744	$ 71,744		
Sand Material	24,480	ton	$ 20	$ 489,600	vendor quote	
Sand Placement	24,480	ton	$ 15	$ 367,200	project experience	Sand Cap placed in multiple lifts
Geotextile Separation Layer	40,000	SF	$ 1	$ 20,000	Vendor quote	Only in nearshore area
Confirmation of Placement	1	LS	$ 20,000	$ 20,000		
Subtotal				*$ 968,544*		
Tax	9.5%		$ 968,544	$ 92,012		Sales Tax
Contingency	25%		$ 1,060,556	$ 265,139		
Total Engineered Sand Cap Cost				$ 1,325,695		
RCM Reactive Capping						
Mobilization/Demobilization	1	LS	$ 48,009	$ 48,009		
Organoclay RCM Material + Transportation	128,937	SF	$ 3	$ 335,235	Quote from Cetco	
Organoclay RCM Placement	128,937	SF	$ 1	$ 128,937	Project experience	
Sand Material	3,865	ton	$ 20	$ 77,293	vendor quote	
Sand Placement	3,865	ton	$ 10	$ 38,646	project experience	Sand over RCM placed in one lift
Confirmation of Placement	1	LS	$ 20,000	$ 20,000		
Subtotal				*$ 648,119*		
Tax	9.5%		$ 648,119	$ 61,571		Sales Tax
Contingency	25%		$ 709,691	$ 177,423		
Total RCM Reactive Capping Cost				$ 887,114		
Upland Soil Solidification						
Mobilization/Demobilization	1	LS	$ 125,174	$ 125,174	percentage of construction costs	includes temporary facilities for duration of construction
Solidification - 8-ft diameter auger	22,352	BCY	$ 70	$ 1,564,673	project experience	8-ft auger used to cost-effectively treat shallower soils
Solidification - 4-ft diameter auger	9,476	BCY	$ 90	$ 852,847	project experience	4-ft auger used to treat deeper soils, below 8-ft auger limit
Subtotal				*$ 2,542,693*		
Tax	9.5%		$ 2,542,693	$ 241,556		Sales Tax
Contingency	30%		$ 2,784,249	$ 835,275		
Total Upland Soil Solidification Cost				$ 3,619,524		
Sediment Removal						
Mobilization/Demobilization	1	LS	$ 303,712	$ 303,712		
Mechanical Dredging	3,107	BCY	$ 30	$ 93,216		Mechanical dredging in nearshore and for offsetting nearshore cap
Hydraulic Dredging	12,200	BCY	$ 60	$ 732,000	Project experience	Assumes specialty hydraulic for T-Dock/Offshore
Debris Removal and Disposal	1	LS	$ 50,000	$ 50,000		Removal of piling
Transloading/Material Handling	14,920	BCY	$ 15	$ 223,800		
Dewatering	14,920	BCY	$ 10	$ 141,740	vendor quote	Assumes 5% amendment by weight
Water Treatment	1	LS	$ 25,000	$ 25,000	Project experience	
Residuals Cover Bulk Organoclay Material - (PM-199)	286	ton	$ 3,250	$ 930,150	Quote from Cetco	
Residuals Cover Sand Material	3,040	ton	$ 20	$ 60,800	vendor quote	
Residuals Cover Material Placement	3,326	ton	$ 15	$ 49,893	project experience	
Backfill Material	16,000	ton	$ 20	$ 320,000	vendor quote	
Backfill Material Placement	16,000	ton	$ 10	$ 160,000	project experience	Backfill placed in bulk
Transportation and Disposal - Non-Hazardous	19,396	ton	$ 50	$ 969,800		Subtitle D landfill disposal
Dredging Confirmation	1	LS	$ 40,000	$ 40,000		
Subtotal				*$ 4,100,111*		
Tax	9.5%		$ 4,100,111	$ 389,511		Sales Tax
Contingency	25%		$ 4,489,621	$ 1,122,405		
Total Sediment Removal Cost				$ 5,612,027		
Sediment Environmental Controls and Monitoring						
Water Quality Monitoring	250	day	$ 2,500	$ 625,000		
Water Quality Controls and BMPs (Absorbent Booms, Silt Curtains, Oil Booms)	1	LS	$ 75,000	$ 75,000		
Odor Control	220	day	$ 2,500	$ 550,000		
Erosion Protection for Shoreline Area	1	LS	$ 250,000	$ 250,000		
Subtotal				*$ 1,500,000*		
Tax	9.5%		$ 1,500,000	$ 142,500		Sales Tax
Contingency	25%		$ 1,642,500	$ 410,625		
Total Sediment Environmental Controls and Monitoring Cost				$ 2,053,125		
DNAPL Collection Trenches						
Mobilization/Demobilization	1	LS	$ 51,705	$ 51,705	Vendor quote	Included with Permeable Treatment Wall costs
Installation	12,500	VSF	$ 40	$ 500,000	Vendor quote	one-pass excavation and backfill including piping and sump
Backfill	1,389	ton	$ 20	$ 27,778	Costworks	pea gravel to 5' bgs, material only
Adsorbent liner	5,000	VSF	$ 4	$ 17,800	Vendor quote	organoclay liner on downgradient wall adjacent PRB - 4 1500ft2 rolls
Transport and Disposal - Non-Hazardous Waste	1,215	ton	$ 50	$ 60,741	project experience	Subtitle D landfill disposal
Transport and Disposal - Hazardous Waste	267	ton	$ 150	$ 40,000	project experience	Subtitle C landfill disposal, assuming no treatment required
Subtotal				*$ 698,024*		
Tax	9.5%		$ 698,024	$ 66,312		Sales Tax
Contingency	25%		$ 764,336	$ 191,084		
Total DNAPL Collection Trenches Cost				$ 955,420		

Table 7 - Preferred Remedy Cost Estimate
Quendall Terminals
Renton, Washington

Permeable Treatment Wall						
Mobilization/Demobilization	1	LS	$ 63,731	$ 63,731	Vendor quote	One Pass trencher transport, assembly and disassembly
Excavation and media installation	1	LS	$ 250,000	$ 250,000	Vendor quote	excavate and place GAC
Treatment media	163	ton	$ 920	$ 149,926	Vendor quote	GAC: see Appendix E
Import fill	44	BCY	$ 30	$ 1,333	Project experience	cap for PRB
Monitoring well installation	5	well	$ 4,000	$ 20,000	Project experience	
Transport and Disposal - Non-Hazardous Waste	2,673	ton	$ 50	$ 133,630	project experience	Subtitle D landfill disposal
Transport and Disposal - Hazardous Waste	587	ton	$ 150	$ 88,000	project experience	Subtitle C landfill disposal, assuming no treatment required
Slurry Wall installation	820	LF	$ 188	$ 153,750	Vendor quote	slurry to 25' depth
Subtotal				*$ 860,370*		
Tax	9.5%		$ 860,370	$ 81,735		Sales Tax
Contingency	25%		$ 942,105	$ 235,526		
Total Permeable Treatment Wall Cost				$ 1,177,631		
Subtotal Construction Costs				**$ 24,526,874**		
Professional Services (as percent of construction and contingency costs)						
Project management	5%		$ 24,526,874	$ 1,226,344		
Remedial design	6%		$ 24,526,874	$ 1,471,612		Includes treatability studies for remedy components as necessary
Construction management	6%		$ 24,526,874	$ 1,471,612		
Subtotal				*$ 4,169,569*		
Total Estimated Capital Cost				**$ 28,700,000**		
O&M COSTS						
1st Year O&M						
GW Monitoring	1	LS	$ 80,000	$ 80,000	Project experience	
Sediment Sand Cap and ENR Sampling	1	LS	$ 25,000	$ 25,000	Project experience	
Sediment Cap Inspection	1	LS	$ 15,000	$ 15,000	Project experience	Visual and In-Water (Bathymetric/ Sediment Profile Image)
Backfilled Area Surface Sediment Monitoring	1	LS	$ 25,000	$ 25,000		
DNR Lease	1	acre	$ 20,000	$ 10,000		
Subtotal				*$ 155,000*		
Tax	9.5%		$ 155,000	$ 14,725		Sales Tax
Contingency	25%		$ 169,725	$ 42,431		
Total 1st Year O&M Cost				$ 212,156		
Annual O&M						
Groundwater Monitoring	1	LS	$ 25,000	$ 25,000	Project experience	20 wells annually
Upland Cap inspection	6	hour	$ 80	$ 480	labor estimate	
DNR Lease	1	acre	$ 20,000	$ 10,000		
Sump Collection and Waste Management	96	hour	$ 80	$ 7,680		monthly
DNAPL Disposal	200	gal	$ 6	$ 1,200		
Subtotal				*$ 44,360*		
Tax	9.5%		$ 44,360	$ 4,214		Sales Tax
Contingency	25%		$ 48,574	$ 12,144		
Total Annual O&M Cost				$ 60,718		
Professional Services (as percent of Annual O&M costs)						
Project management/Reporting	10%		$ 60,718	$ 6,072		
Total, Annual O&M:				**$ 66,790**		
Total Estimated O&M, 100 Years, No NPV Analysis:				**$ 6,900,000**		
Periodic Costs						
Reactive Cap						
Replace 25% of RC at 22 yrs				$ 160,000		
Replace 25% of RC at 44 yrs				$ 160,000		
Replace 25% of RC at 66 yrs				$ 160,000		
Replace 25% of RC at 88 yrs				$ 160,000		
Sand Cap and ENR						
Sediment Sand Cap and ENR Sampling at 2 years				$ 25,000		
Sediment Sand Cap and ENR Sampling at 5 years				$ 25,000		
Sediment Sand Cap and ENR Sampling at 10 years				$ 25,000		
Sediment Cap Inspection at 2 years				$ 15,000		
Sediment Cap Inspection at 5 years				$ 15,000		
Sediment Cap Inspection at 10 years				$ 15,000		
Sand Cap Shoreline Maintenance at 30 years				$ 25,000		
Sand Cap Shoreline Maintenance at 60 years				$ 25,000		
Sand Cap Shoreline Maintenance at 90 years				$ 25,000		
Permeable treatment wall						
Replace Media at 22 yrs				$ 528,842		includes mob/demob, excavation, media, and $400 per ton disposal fee
Replace Media at 44 yrs				$ 528,842		includes mob/demob, excavation, media, and $400 per ton disposal fee
Replace Media at 66 yrs				$ 528,842		includes mob/demob, excavation, media, and $400 per ton disposal fee
Replace Media at 88 yrs				$ 528,842		includes mob/demob, excavation, media, and $400 per ton disposal fee
Subtotal				*$ 2,950,369*		
TOTAL ESTIMATED COST, NO NPV ANALSYS				**$ 38,550,369**		
Net Present Value Analysis						
Annual O&M	100	year	$ 66,790	$ 3,320,818		
1st year O&M	1	LS	$ 212,156	$ 212,156		
Replace 25% of RC at 22 yrs	1	LS	$ 160,000	$ 112,839		
Replace 25% of RC at 44 yrs	1	LS	$ 160,000	$ 79,579		
Replace 25% of RC at 66 yrs	1	LS	$ 160,000	$ 56,122		
Replace 25% of RC at 88 yrs	1	LS	$ 160,000	$ 39,580		
Sediment Sand Cap and ENR Sampling at 2 years	1	LS	$ 25,000	$ 24,219		
Sediment Sand Cap and ENR Sampling at 5 years	1	LS	$ 25,000	$ 23,093		
Sediment Sand Cap and ENR Sampling at 10 years	1	LS	$ 25,000	$ 21,331		
Sediment Cap Inspection at 2 years	1	LS	$ 15,000	$ 14,531		
Sediment Cap Inspection at 5 years	1	LS	$ 15,000	$ 13,856		
Sediment Cap Inspection at 10 years	1	LS	$ 15,000	$ 12,798		
Sand Cap Shoreline Maintenance at 30 years	1	LS	$ 25,000	$ 15,528		
Sand Cap Shoreline Maintenance at 60 years	1	LS	$ 25,000	$ 9,645		
Sand Cap Shoreline Maintenance at 90 years	1	LS	$ 25,000	$ 5,991		
Replace PRB Media at 22 yrs	1	LS	$ 528,842	$ 372,962		
Replace PRB Media at 44 yrs	1	LS	$ 528,842	$ 263,029		
Replace PRB Media at 66 yrs	1	LS	$ 528,842	$ 185,499		
Replace PRB Media at 88 yrs	1	LS	$ 528,842	$ 130,822		
2013 discount rate for NPV	1.6%					
Total Estimated O&M and Periodic NPV				**$ 4,914,397**		
TOTAL ESTIMATED COST				**$ 33,614,397**		

Notes:
1. Mobilization/Demobilization costs are assumed to include equipment transport and setup, temporary erosion and sedimentation control (TESC) measures, bonds, and insurance.
2. Contingency costs include miscellaneous costs not currently itemized due to the current (preliminary) stage of design development, as well as costs to address unanticipated conditions encountered during construction.

Table 8 - Summary of Remedial Alternative Cost Estimates with Preferred Remedy

Quendall Terminals
Renton, Washington

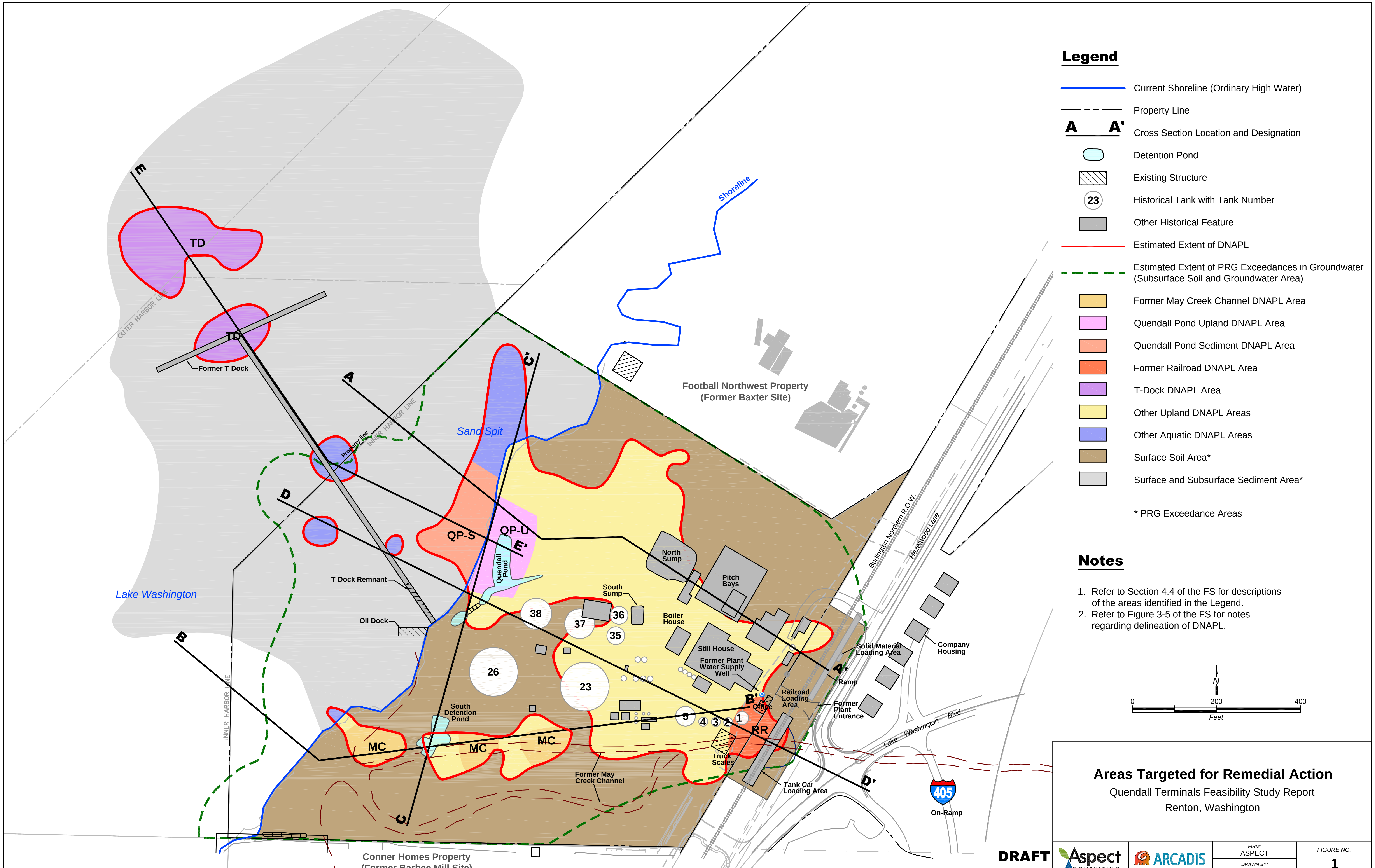
Alternative	Total Estimated Cost[1] Without NPV Analysis	Total Estimated Cost[1] With NPV Analysis[2]
Alternative 1 - No Action	$ 0	$ 0
Alternative 2 - Containment	$ 33,500,000	$ 26,000,000
Preferred Remedy - Containment with Targeted Source Materials Solidification (RR, MC, and QP-U DNAPL Areas) and Removal (TD DNAPL Area)	$ 38,600,000	$ 33,600,000
Alternative 4 - Containment with Targeted PTM Removal (TD, QP-S, and QP-U DNAPL Areas)	$ 49,100,000	$ 44,300,000
Alternative 5 - Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 4-Foot-Thickness) and Removal (TD and QP-S DNAPL Areas) (TD and QP-S DNAPL Areas)	$ 50,700,000	$ 46,500,000
Alternative 6 - Containment with Targeted PTM Solidification (RR and MC DNAPL Areas and ≥ 2-Foot-Thickness) and Removal (TD, QP-S, and QP-U DNAPL Areas) (TD, QP-S, and QP-U DNAPL Areas)	$ 64,800,000	$ 60,600,000
Alternative 7 - Containment with PTM Solidification (Upland) and Removal (Sediment)	$ 82,800,000	$ 80,400,000
Alternative 8 - Containment with PTM Removal (Upland and Sediment)	$ 142,000,000	$ 140,000,000
Alternative 9 - Containment with Solidification and Removal of Contaminated Soil and Removal of Contaminated Sediment	$ 264,000,000	$ 262,000,000
Alternative 10 - Containment with Removal of Contaminated Soil and Sediment	$ 439,000,000	$ 409,000,000

Notes:

1. Estimated costs are rounded to three significant figures.
2. A 1.6% discount rate was used in the net present value analysis.

NPV - Net Present Value

PTM = principal threat materials; the PTM terminology is retained here when describing FS Remedial Alternative titles to be consistent with the terminology in the FS.



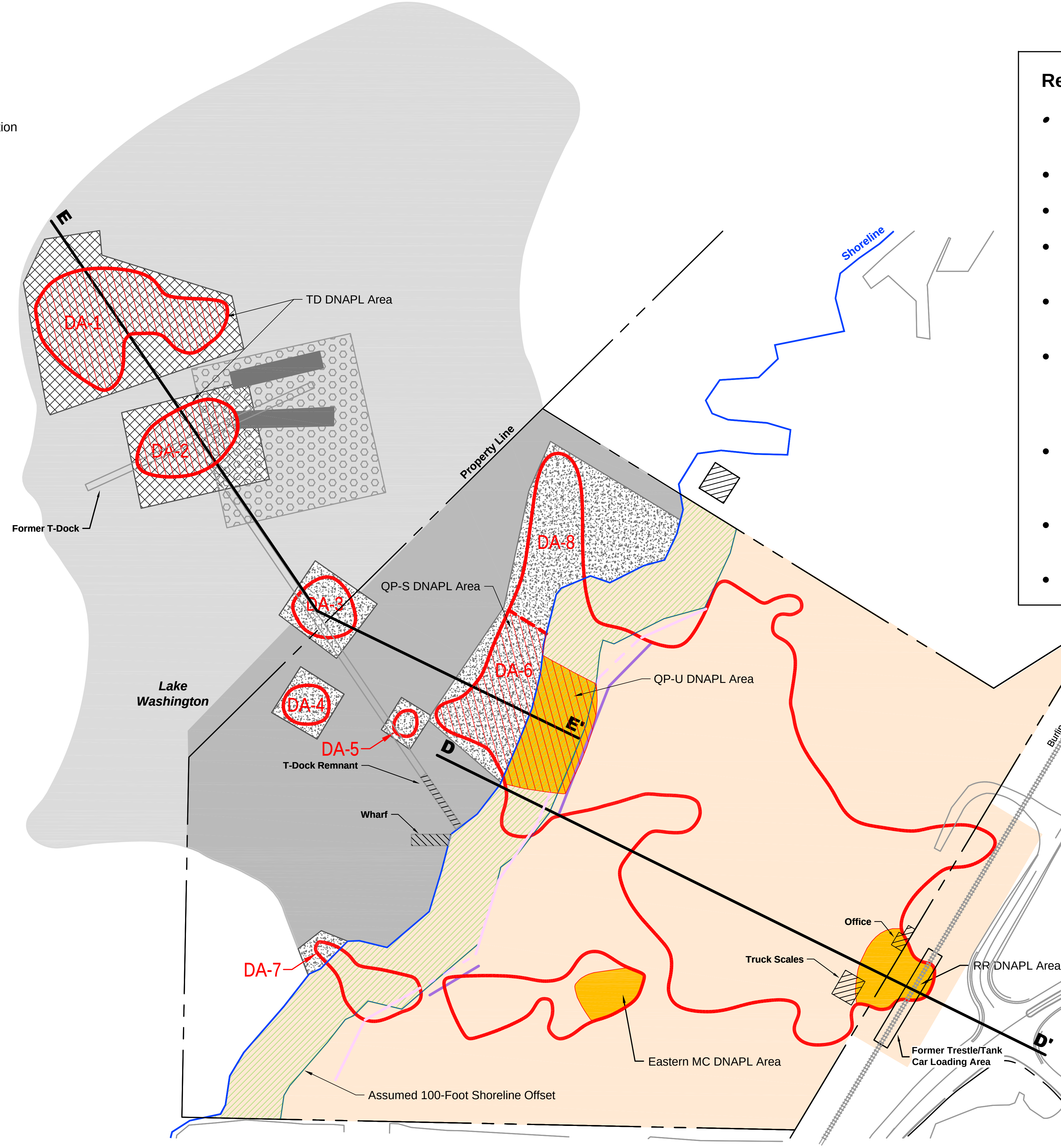
Areas Targeted for Remedial Action
Quendall Terminals Feasibility Study Report
Renton, Washington

Legend

- D — D' Cross Section Location and Designation
- Existing Structure
- DNR Dry Dock Cap
- DNR Dry Dock Concrete Hulls
- Estimated Extent of DNAPL
- Permeable Treatment Gate
- Impermeable Funnel
- DNAPL Collection Trench
- Habitat Area
- Permeable Cap
- Solidified Soil
- Enhanced Natural Recovery
- Engineered Sand Cap (Note 1)
- Dredge Area
- RCM Reactive Cap (Note 1)
- DA-1 Aquatic DNAPL Area
- Higher-Risk DNAPL Area

Note:

1. The preferred remedy includes sediment removal (not shown on this figure) from the shoreline to approximately 75 feet offshore in areas where engineered sand cap and RCM reactive cap are to be placed, to maintain the existing nearshore area profile.



Remedy Components:

- *In situ* solidification of source materials in the RR, MC, and QP-U DNAPL Areas;
- DNAPL collection trenches along the shoreline;
- An upland cap east of the shoreline;
- A permeable reactive barrier (PRB) along the shoreline;
- Sediment source materials removal with a reactive residuals cover in the TD DNAPL Area;
- A reactive sediment cap composed of a Reactive Core Mat® (RCM) above sediment source materials that are not removed, including in the QP-S DNAPL Area (or option for an amended sand cap);
- Enhanced natural recovery (ENR) of offshore sediments exceeding the background threshold value (BTV) outside source materials areas;
- Engineered sand cap on nearshore sediments outside source materials areas; and
- Institutional controls and monitoring.

DRAFT

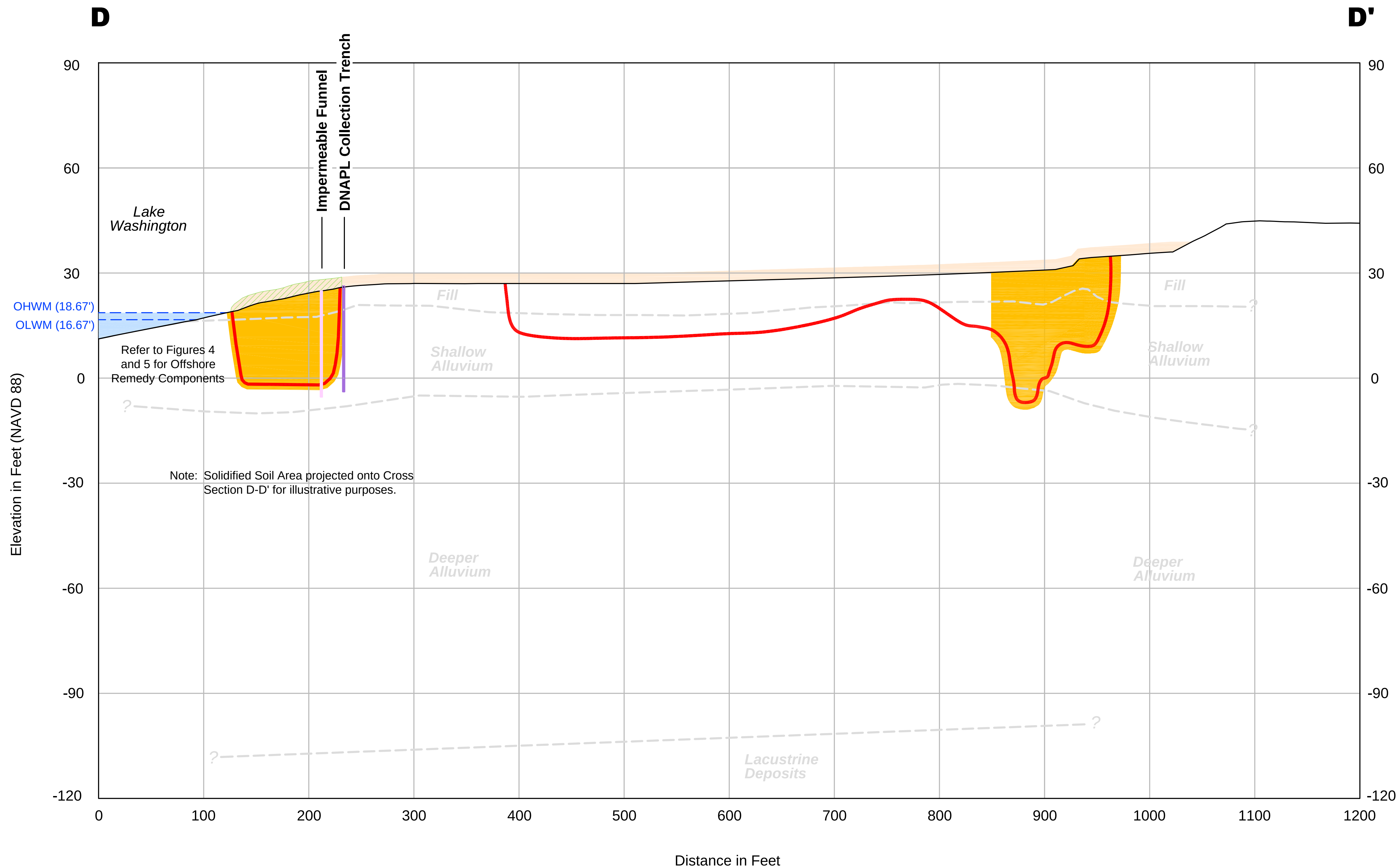
Preferred Remedy - Remedy Components

Quendall Terminals
Renton, Washington

Aspect CONSULTING | ARCADIS

FIRM: ASPECT
DRAWN BY: JJP/ELG/PMB/SCC
FIGURE NO. 2

CAD Path: Q:\Quendall\020027 Quendall Terminals\2013-06 FS Draft Final\White Paper\020027_Plan-Alternatives_Preferred SCC.dwg 1-Preferred Remedy || Date Saved: Feb 28, 2014 10:12am || User: scudd



Legend

Solidified Soil

Permeable Cap

Permeable Cap/Habitat Area

Estimated Extent of DNAPL (Refer to Figure 1 for Basis.)

Horizontal Scale 0 100 200 *Feet*

Vertical Scale 0 30 60 *Feet*

Vertical Exaggeration x 3.33

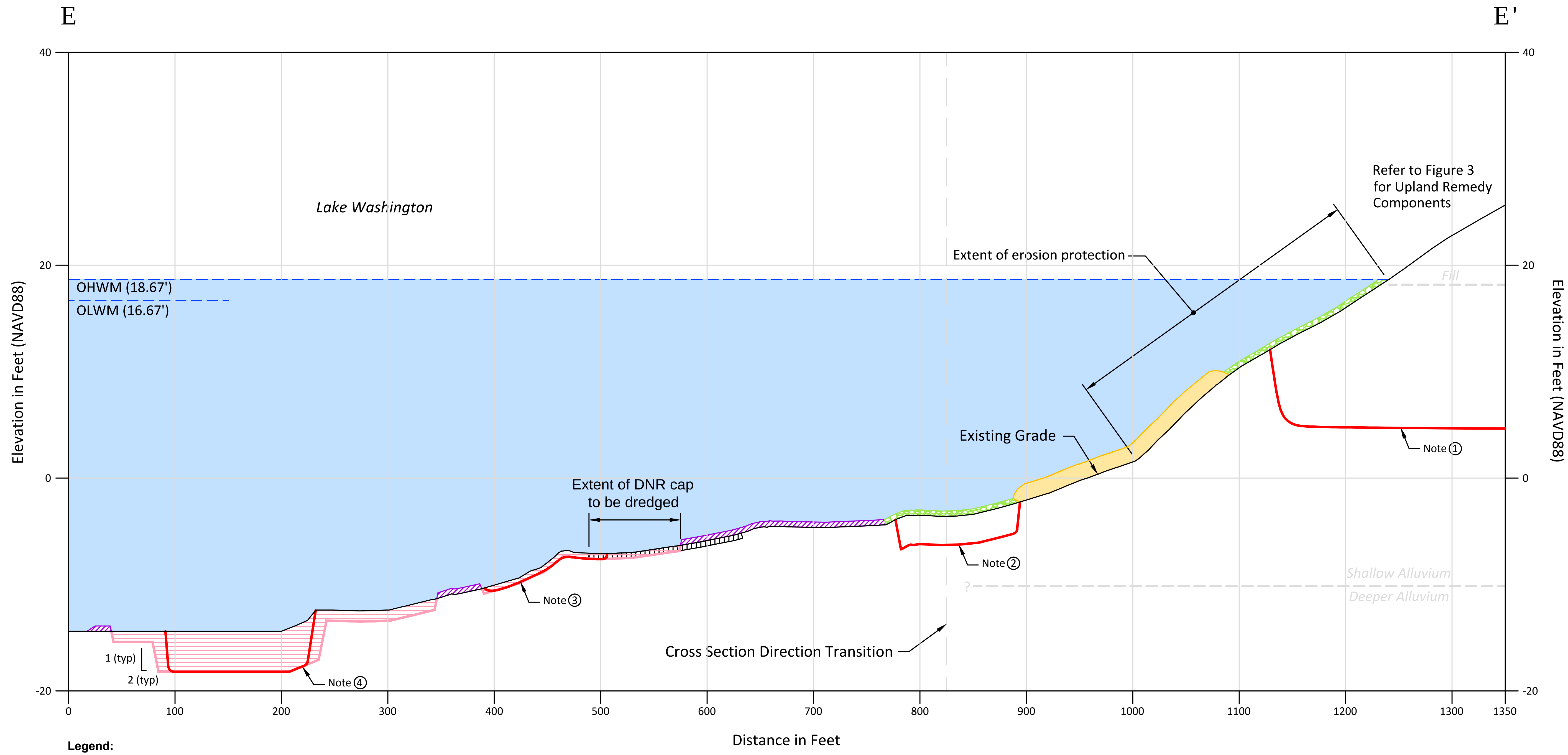
DRAFT

Preferred Remedy-Upland Remedy Components along Cross Section D-D'

Quendall Terminals Feasibility Study Report
Renton, Washington

Aspect CONSULTING | ARCADIS | FIRM: ASPECT | DRAWN BY: JJP/PMB/ELG/SCC | FIGURE NO. 3

CAD Path: Q:\Quendall\020027 Quendall Terminals\2013-06 FS Draft Final\White Paper\020027_SectionD-Alternatives 2-8_Preferred SCC.dwg ALT 4 NEW || Date Saved: Feb 28, 2014 11:53am || User: scudd



Legend:

- Existing DNR Dry Dock Cap
- Estimated extent of DNAPL, based on maximum depth of DNAPL observed in the noted explorations
- RCM Reactive cap (organoclay RCM covered by 0.5 ft of sand with erosion protection as required)
- Engineered sand cap (1.5 ft of sand with erosion protection as required)
- Enhanced Natural Recovery (0.5 ft of sand)
- Dredging (removal to designated depths, residual cover placement, and backfilled as required)

Notes:

① Boring SP-3 and sediment core VS 30
② Sediment core VS 27
③ Sediment cores EPA-1 and TD 08
④ Sediment cores VT 4 and VT 1
⑤ Only offshore remedy components are depicted in this figure

Horizontal Scale

0 100 200
Feet

Vertical Scale

0 10 20
Feet

Vertical Exaggeration x 10

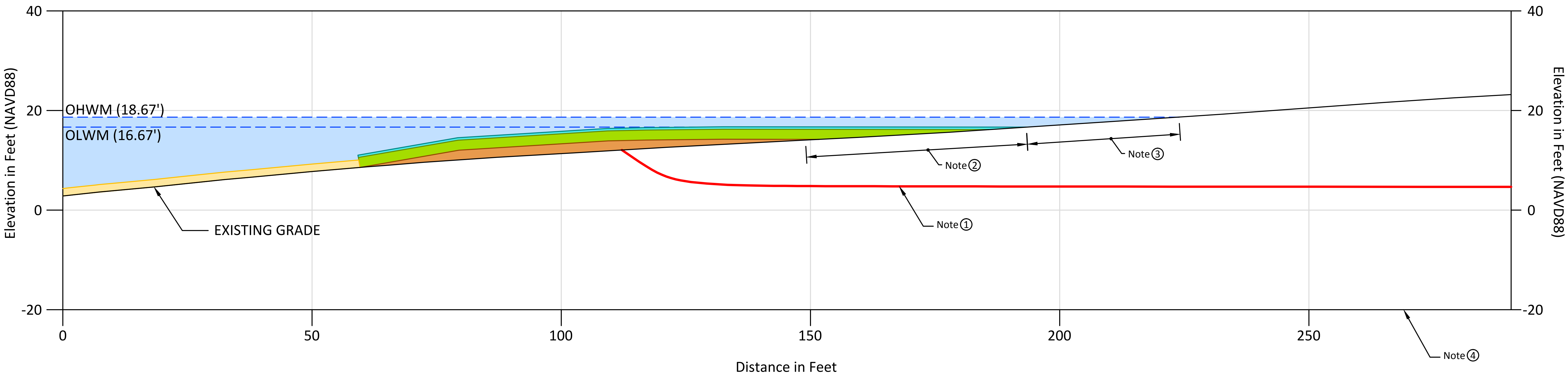
DRAFT

Preferred Remedy - Offshore Remedy Components along Cross Section E-E'

Quendall Terminals Feasibility Study Report
Renton, Washington

Aspect CONSULTING | ARCADIS | FIRM: ARCADIS | DRAWN BY: BKD | FIGURE NO. 4

CAD Path: G:\ENVCAD\SYRACUSE\ACT\WA000907\0000\00001\DWG\REPORT\00090702.dwg 4 || Date Saved: Feb 28, 2014 1:03pm || User: GSTEINBERGER



Legend:

Estimated extent of DNAPL, based on maximum depth of DNAPL observed in the noted explorations

Amended Sand Reactive Cap:
- 0.5 ft of aquatic habitat friendly material
- 2.0 ft of clean sand
- 2.0 ft of sand (90%) and organoclay (10%) mix

Engineered sand cap (1.5 ft of sand with erosion protection as required)

Notes:

1. Boring SP-3 and sediment core VS 30
2. Extent of dredge offset area to accommodate Amended Sand Cap
3. Extent of offset area to accommodate Upland Remedial Component
4. Section starts at station 1000 on the Figure 6-26 of Draft Final Feasibility Study Report

0 20 40
Feet
Approximate Scale

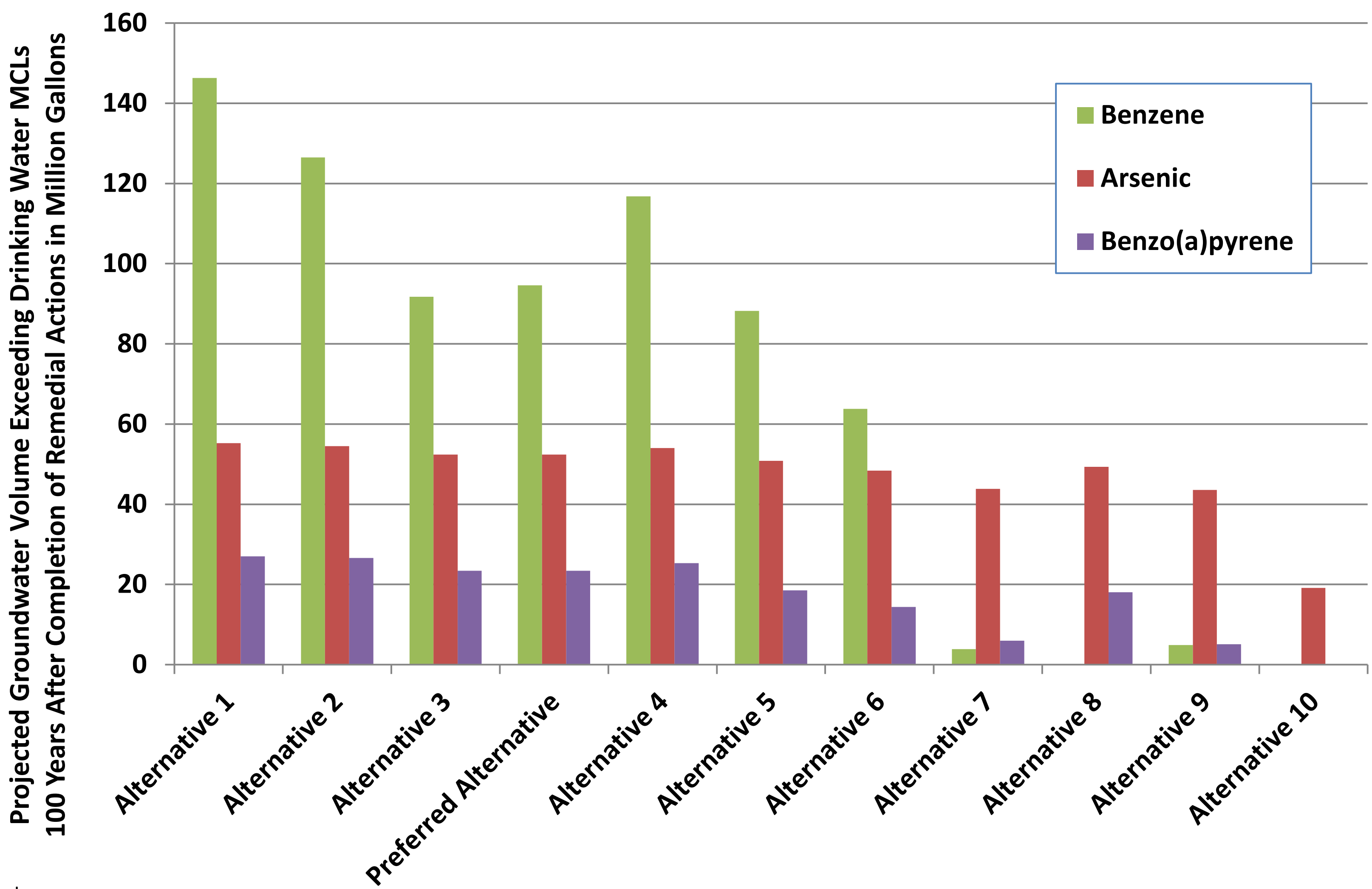
DRAFT

Preferred Remedy -
Amended Sand Cap Cross Section
Quendall Terminals Feasibility Study Report
Renton, Washington

Aspect CONSULTING | ARCADIS | FIRM: ARCADIS DRAWN BY: BKD | FIGURE NO. 5

CAD Path: G:\ENVCAD\SYRACUSE\ACT\WA000907\0000\00001\DWG\REPORT\00090TG03.dwg 5 || Date Saved: Feb 28, 2014 9:26am || User: GSTEINBERGER

Figure 6 - Projected Restoration in All Aquifers 100 Years After Implementation of Alternative Remedial Actions with Preferred Remedy
Quendall Terminals



Note:
Restoration of groundwater for benzene is estimated based on bezene half-life of 340 days.

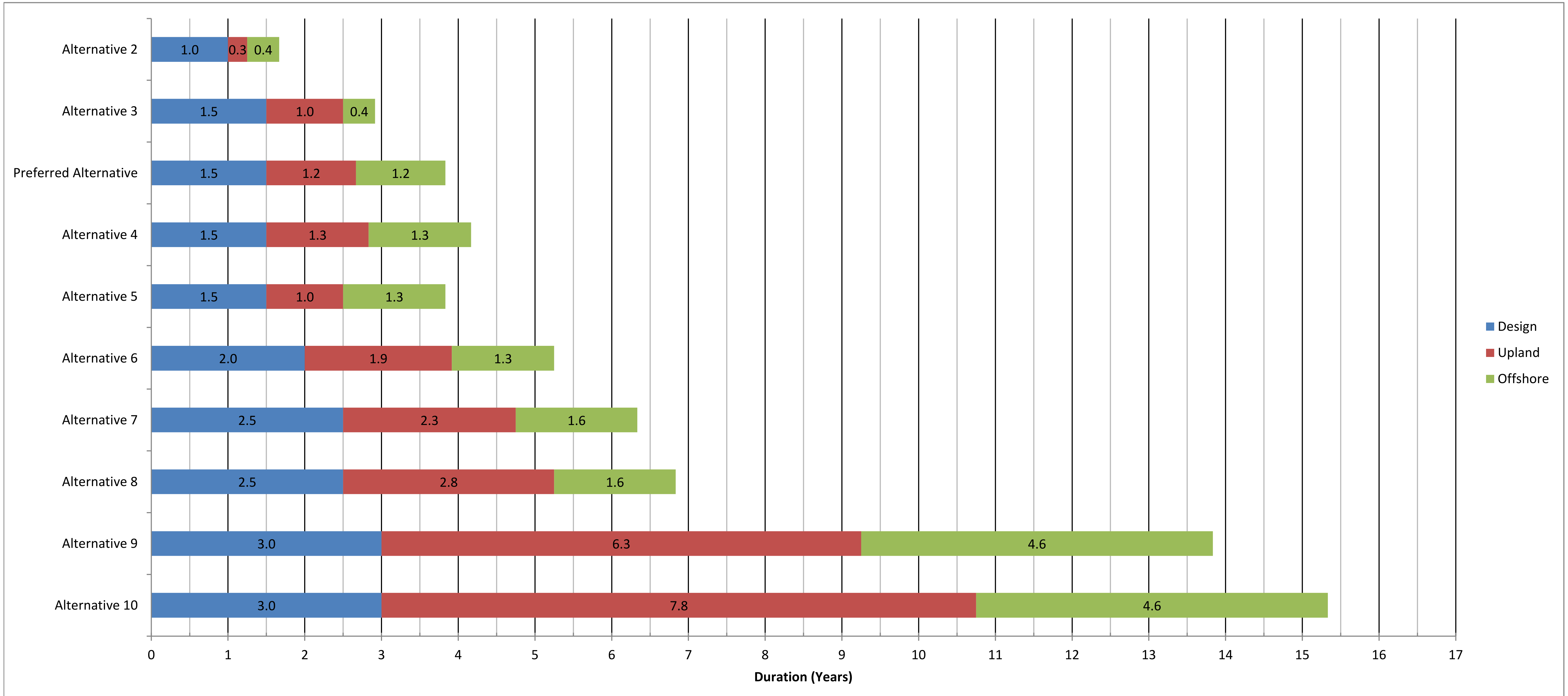
DRAFT

Figure 6
Preferred Remedy Memorandum

Aspect Consulting
3/12/2014
V:\020027 Quendall Terminals\FS Report\Preferred Remedy Letter\Client Review Drafts\March 2014 Version\Figures\Figure 5.xlsx

Figure 7 - Summary of Estimated Remedy Design and Construction Durations with Preferred Remedy

Quendall Terminals
Renton, Washington



Notes:

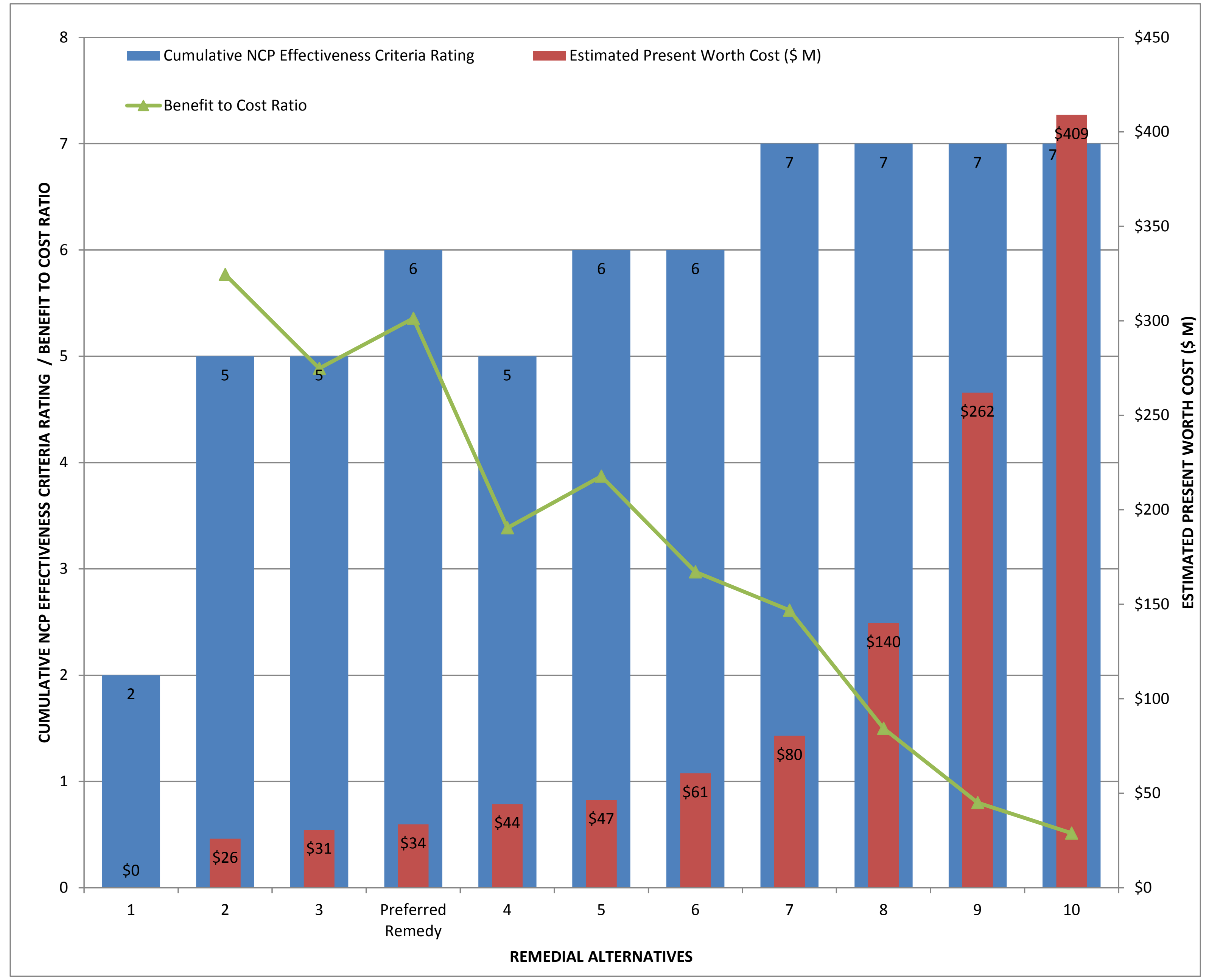
DRAFT

1) Construction durations include work stoppage for the fish window for offshore work conducted outside of the sediment removal enclosures. It is assumed that work within the enclosures may be conducted within the fish window (outside the in-water work window).

2) The construction durations assume that upland work is completed prior to offshore work implementation. However, some upland and offshore work may be conducted concurrently.

Figure 9 - Cost Effectiveness of FS Alternatives and Preferred Remedy
Quendall Terminals
Renton, Washington

Remedial Alternative	Estimated Present Worth Cost ($ M)	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Cumulative NCP Effectiveness Criteria Rating	Benefit to Cost Ratio (NCP Balancing Criteria Rating /Estimated Present Worth Cost)(30 X scaling factor)
1	$0	0	0	2	2	--
2	$26	1	1	3	5	5.77
3	$31	1	1	3	5	4.89
Preferred Remedy	$34	2	1	3	6	5.36
4	$44	2	1	2	5	3.39
5	$47	2	2	2	6	3.87
6	$61	2	2	2	6	2.97
7	$80	3	3	1	7	2.61
8	$140	3	3	1	7	1.50
9	$262	3	3	1	7	0.80
10	$409	3	3	1	7	0.51



DRAFT

ATTACHMENT B

Quendall Terminals Site Preferred Remedy.

Memorandum to US EPA National Remedy Review Board, April 24, 2014

MEMORANDUM

Project No.: 020027

April 24, 2014

To: U.S. Environmental Protection Agency National Remedy Review Board

cc: Robert Cugini, RueAnn Thomas, Lynn Manolopoulos, and Jim Hanken

From: Aspect Consulting on behalf of Quendall Terminals

Re: **Quendall Terminals Site Preferred Remedy**
Renton, Washington

Introduction

The Respondents recently submitted to the U.S. Environmental Protection Agency (EPA) a memorandum (Preferred Remedy Memorandum: Aspect and Integral 2014) describing the scope and rationale for a proposed preferred remedy for the Quendall Terminals Site (Site). We understand that EPA Region 10 (Region 10) does not support selection of the preferred remedy and is instead proposing to select Alternative 7 of the Draft Feasibility Study (Aspect and Arcadis 2013). We understand Region 10 has provided the National Remedy Review Board (NRRB) with their rationale for why the Respondents' preferred remedy should not be selected by the agency but they have not shared this NRRB submittal with the Respondents. However, in a meeting on April 16, 2014, Region 10 verbally communicated several reasons for their preference for Alternative 7 and indicated that they believe Alternative 7 is the lowest-cost alternative in the Feasibility Study (FS) that satisfies the National Contingency Plan (NCP) statutory requirements. We respectfully disagree with Region 10 in this regard and in addition believe that in recommending Alternative 7, Region 10 failed to adequately consider the NCP balancing criteria—a key component of the remedy selection process.

This memorandum explains why Region 10's rationale for selecting Alternative 7 is flawed and why the Respondents' preferred alternative meets the statutory requirements. This letter also reiterates why the Respondents' preferred remedy should be selected. A full description of the Respondents' preferred remedy and the rationale for selecting it for this Site is provided in the Preferred Remedy Memorandum (Aspect and Integral 2014).

Remedy Selection

Region 10 has verbally communicated that they believe that the only alternatives that satisfy statutory requirements and qualify the Site for a TI waiver are those that include treatment or removal of all dense non-aqueous phase liquid (DNAPL) impacted soil and sediments (i.e., FS Alternatives 7 through 10). Under Alternative 7, this is accomplished by *in situ* solidification of an estimated 240,000 cubic yards of soil and removal of an estimated 50,000 cubic yards of sediment.

Notwithstanding the problems with implementing Alternatives 7 through 10 and their significant costs, these alternatives would not restore groundwater to its highest beneficial use, nor offer significantly more protectiveness than the Respondents' preferred remedy, and would negatively impact the surrounding community. Region 10's rationale for selecting these alternatives is inconsistent with the NCP and with EPA guidance, which require evaluation of all balancing criteria and consideration of the tradeoffs of various levels of treatment when selecting a remedy.

Region 10 has not adequately considered the variation in DNAPL risk at the Site. The Respondents' preferred remedy focuses on potentially mobile DNAPL close to Lake Washington and deep source materials impacting deeper groundwater, resulting in the treatment or removal of approximately 50,000 cubic yards of impacted soil and sediment, comprising approximately 26 percent of the total DNAPL estimated to be at the Site. The remaining Site DNAPL cannot be removed or treated without also removing or treating substantial volumes of relatively clean overburden soils or sediments (resulting in increased costs and extended construction durations and impacts). This remaining Site DNAPL, much of which is present in highly dispersed seams or thin layers, can: 1) be reliably contained through proven and reliable engineering and institutional controls that are consistent with the proposed future Site use (mixed commercial development); and 2) does not represent a significant future risk to human health and the environment due to its location on the Site (e.g., distance from the lake or other receptor) and/or low mobility (e.g., highly weathered and/or migration-limited by low-permeability layers).

The Respondents' preferred remedy:

- Meets the statutory requirements by satisfying the threshold criteria of protectiveness and achieving compliance with Applicable or Relevant and Appropriate Requirements (ARARs; except for groundwater maximum contaminant levels [MCLs], which are technically impracticable to achieve); restoring groundwater to the maximum extent practicable; treating or removing principal threats posed by the Site; and being cost-effective.

- Provides the best balance of NCP evaluation criteria by removing or treating source materials (i.e., DNAPL-impacted materials) that pose the highest long-term Site risk, while avoiding to the extent possible short-term impacts and significant implementability constraints. In addition, the Respondents' preferred remedy does not incur the much higher costs associated with dredging or excavating large quantities of source materials that pose low long-term Site risk.

EPA must balance the trade-offs among the alternatives, taking into account not only the preference for treatment and the expectations for groundwater restorations to the extent practicable[1], but also the relative cost of the alternatives. The NCP (40 CFR 300.430(a)(1)(iii)(D)) states: "the use of institutional controls shall not substitute for active response measures (e.g., treatment *and/or containment* of source material, restoration of ground waters to their beneficial uses) as the sole

[1] Note that the evaluation of groundwater restoration to the extent practicable, which depends on the balance of tradeoffs between remedial alternatives, is different from the evaluation of technical impracticability that forms the basis for warranting an ARAR waiver. Restoration of groundwater to achieve MCLs at the Site is determined to be technically impracticable based on the findings of the detailed evaluation of alternatives contained in the FS evaluation, as described below under Compliance with ARARs.

remedy unless such active measures are determined not to be practicable, *based on the balancing of trade-offs among alternatives that is conducted during the selection of remedy* [emphasis added].” In evaluating cost, the NCP states a remedial alternative is cost-effective if its costs are proportional to its overall effectiveness (40 CFR 300.430(f)(1)(ii)(D)).

The reasons for selecting the Respondents’ preferred remedy versus Alternatives 7 through 10 include:

- The Respondents’ preferred remedy includes a combination of dredging and capping of contaminated sediments to provide long-term protectiveness while minimizing short-term impacts. The increased short-term impacts (including water quality impacts), and the cost of extensive source materials dredging under Alternatives 7 through 10 outweigh the benefits of removing highly dispersed source materials in sediment that can be reliably contained through a combination of engineered caps and upland source treatment.

- The Respondents’ preferred remedy includes a combination of *in situ* treatment of high-risk source materials and containment of low-risk source materials that can be reliably contained. The increased short-term impacts and cost of extensive upland source materials treatment under Alternatives 7 through 10 outweigh the benefits of removing highly dispersed source materials in soil that can be reliably contained through a combination of engineered caps, groundwater treatment walls, and DNAPL collection trenches. Furthermore, Alternatives 7 through 10 are highly likely to leave residual DNAPL in spite of extensive removal and treatment due to the heterogeneity of the subsurface and dispersed nature of DNAPL occurrences.[2]

- The Site would qualify for a waiver of achieving groundwater MCLs because full restoration of groundwater under any of the FS alternatives, including Alternatives 7 through 10 (the most aggressive alternatives considered in the FS), is technically impracticable. In particular, restoration of groundwater is technically impracticable for recalcitrant contaminants such as benzo(a)pyrene and arsenic in the heterogeneous soils (interbedded sand, silty sand, and peat) of the shallow aquifer. Furthermore, the Site is bordered by state cleanup sites with residual groundwater contamination and accompanying deed restrictions. However, the Respondents’ preferred remedy eliminates deep groundwater contamination through source materials treatment and controls shallow groundwater contamination using a combination of source materials treatment and groundwater treatment.

- The Respondents’ preferred remedy satisfies Comprehensive, Environmental Response, Compensation, and Liability Act requirements for treatment and groundwater restoration to the maximum extent practicable by providing the best balance of NCP balancing criteria.

[2] Region 10 has previously stated that the apparent lack of dredging residuals at the ongoing Boeing Plant 2 dredging project on the Duwamish River is proof that dredging can prevent residual contamination but the results at Boeing Plant 2 are not dispositive because the site contaminant is polychlorinated biphenyls (PCBs) and not a coal tar NAPL.

- The Respondents’ preferred remedy is cost-effective by providing the best balance of overall effectiveness and cost.

Timing of TI Waiver

Region 10 has verbally communicated that they believe that the only alternatives that satisfy statutory requirements and qualify the Site for a TI waiver are those that include treatment or removal of all DNAPL-impacted soil and sediments (i.e., FS Alternatives 7 through 10). However, FS Alternatives 7 through 10 would not restore groundwater to its highest beneficial use, nor offer significantly more protectiveness than the Respondents’ preferred remedy, yet cost significantly more and negatively impact the surrounding community to a much greater degree than the Respondents’ preferred remedy. Even the TI waiver guidance recognizes that “[t]he appropriate level of effort for source removal and remediation must be evaluated on a site-specific basis, considering the degree of risk reduction and any other potential benefits that would result from such an action.” (EPA 1993).

We understand that Region 10 believes that if implementation of Alternative 7 does not achieve groundwater restoration, they will then consider a TI Waiver at the 5- or 10-year review period. Extensive groundwater modeling completed at the direction of Region 10 as part of the FS indicates that groundwater restoration is not achievable within a reasonable restoration timeframe at the Site for even the most aggressive alternatives. Given the extremely low likelihood that groundwater will be restored within a 5- or 10-year review period or a reasonable timeframe, selection of Alternative 7 will almost certainly require a TI waiver and will thus yield no tangible benefits over the Respondents’ preferred remedy, at more than double the cost.

Conclusion

The Respondents’ preferred remedy meets the statutory requirements by satisfying the threshold criteria of protectiveness and achieving compliance with ARARs (except for groundwater MCLs, which are technically impracticable to achieve); restoring groundwater to the maximum extent practicable; treating or removing principal threats posed by the Site; and being cost-effective. It also provides the best balance of NCP evaluation criteria by removing or treating source materials (i.e., DNAPL-impacted materials) that pose the highest long-term Site risk, while avoiding to the extent possible short-term impacts and significant implementability constraints. In addition, the Respondents’ preferred remedy would not incur the much higher costs associated with dredging or excavating large quantities of source materials that pose low long-term Site risk.

In contrast, Region 10’s recommendation of Alternative 7 is inconsistent with the NCP and EPA guidance, which require evaluation of all balancing criteria and consideration of the tradeoffs of various levels of treatment when selecting a remedy. Alternative 7 or other more aggressive alternatives evaluated in the FS would not restore groundwater to its highest beneficial use, nor offer significantly more protectiveness than the Respondents’ preferred remedy, but would incur much higher costs and would negatively impact the surrounding community.

Based on the above considerations, the Respondents’ preferred remedy should be selected for the Quendall Terminals Site.

References

Aspect Consulting, LLC and ARCADIS (Aspect and Arcadis), 2013, Draft Feasibility Study, October 14, 2014.

Aspect Consulting, LLC and Integral (Aspect and Integral), 2014, Preferred Remedy Memorandum, March 14, 2014.

U.S. Environmental Protection Agency, 1993, Guidance for Evaluating Technical Impracticability of Ground-Water Restoration. OSWER Directive 9234.2-25, September 1993.

V:\020027 Quendall Terminals\FS Report\Preferred Remedy Letter\Respondent Submittal NRRB April 2014\Quendall Terminals Preferred Remedy - Respondent Submittal to NRRB April 2014.docx

ATTACHMENT C

EPA Comments on the Draft Final Feasibility Study. Letter to Lynda Priddy, EPA, October 30, 2014

October 30, 2014

Lynda Priddy
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-115
Seattle, Washington 98101-3140

Re: EPA Comments on the Draft Final Feasibility Study
Quendall Terminals Superfund Site, Renton, Washington
Docket No.: CERCLA-10-2006-0325

Dear Ms. Priddy:

The Respondents have reviewed the EPA's comments on the Quendall Terminals draft final Feasibility Study (FS), which were received on October 9, 2014. In its comments, the EPA directs the Respondents to make significant changes to the FS that we believe are inconsistent with the EPA's policies and its application of these policies at other Superfund sites. Many other directed changes are technically unsupported and based on what we believe are erroneous suppositions. The intent of this letter is to convey the nature of our concerns, provide the EPA with specific examples that document these concerns, and propose a path forward for revising and finalizing the FS.

This letter does not provide a comprehensive listing and discussion of all the issues we have with the EPA's comments but we would be happy to provide that level of detail if it would be helpful to the EPA. Instead, we are providing a summary of some of the key policy and technical issues and some specific examples to illustrate the Respondents' concerns. We hope this will provide a basis for further discussion between the Respondents and the EPA.

Example policy issues:

- **Basis for a Technical Impracticability (TI) Waiver.** The EPA rejects 7[1] of the 11 FS alternatives based on the assumption that these would not qualify for a TI Waiver, and therefore eliminates these alternatives from the comparative analysis of alternatives. The EPA's rationale is largely based on the groundwater modeling results, which are acknowledged by the EPA to be very conservative and contain a high degree of uncertainty (see Section 7.1.1.2 paragraph 2), and on the EPA's belief that Alternatives 7 through 10 may achieve MCLs in groundwater throughout the Site. We disagree that Alternatives 7 through 10 will achieve MCLs and believe it is premature, based on the uncertainty and conservativeness of the model, to exclude Alternatives 2 through 6 from the comparative analysis in the FS.
- **Treatment of Principal Threat Wastes (PTWs).** The EPA takes the position that: 1) all DNAPL-containing materials are PTWs; and 2) all of these materials **must** be treated to satisfy statutory requirements. This is inconsistent with EPA policy, as the NCP only establishes an **expectation** that the EPA will use treatment to address the principal threats posed by a site **wherever practicable** (NCP §300.430(a)(1)(iii)(A)). The EPA's extreme position in the FS comments that all PTWs (in this case DNAPL-containing materials) must be treated is not supported by the large number of Superfund site remedies where only a portion of the DNAPL contamination was designated as PTW and a portion was contained and controlled rather than treated. The following are examples of Superfund sites with remedies involving containment of DNAPL:
    - **UTAH Power & Light/American Barrel Co**
    - **Pacific Sound Resources (PSR)**
    - **McCormick and Baxter**

[1] Alternatives 1 through 4, 4a, 5, and 6.

- **Overall Protectiveness.** The EPA incorrectly states that Alternatives 1 through 6 do not meet the threshold criterion for overall protectiveness because these alternatives do not qualify for a TI Waiver for MCL exceedances in groundwater. Although this criterion draws on evaluations done under other criteria, including ARAR compliance, the fundamental question is whether the alternative achieves protection of human health and the environment. At numerous Superfund sites, the EPA has concluded that remedies are protective even if MCLs are exceeded in groundwater. An example is the McCormick and Baxter site, where the EPA determined that the selected remedy, which included deed restrictions prohibiting groundwater use to address MCL exceedances in groundwater, was protective of human health and the environment.

Example technical issues:

- **Groundwater Restoration.** The EPA states that *"the timeframes for Alternatives 8 and 10 may also be relevant for Alternatives 7 and 9, given that the extent of benzene MCL exceedances based on empirical data are smaller than the model predicts, in situ solidification is likely to oxygenate the subsurface and aid in volatile attenuation, and the resulting solidified materials are not considered to be aquifer materials."* (Page ES-14). EPA also states that *"Alternatives 7 through 10 would likely comply with the MCL ARAR."* (Page ES-13).

  These statements have no technical basis. There are many factors that can cause the model to conservatively predict the size of a plume but otherwise have no significant effect on the restoration time frame. The EPA provides no calculations nor does it reference case studies that show how oxygen—that may be introduced during solidification—will significantly degrade residual contamination. Additionally, the EPA inconsistently applies its evaluation of model conservativeness. While stating that the model results for Alternatives 7 through 10 are conservative, the EPA does not make the same judgment regarding model results for Alternatives 1 through 6. Because of its simplifying and conservative assumptions, the model will overpredict the extent of groundwater contamination for all alternatives.

- **DNAPL Mobility and Reliability of DNAPL Containment.** The EPA states that *"DNAPL at the Quendall Site, whether in soils or sediments, is considered as PTW because of the high level of toxicity inherent in the creosote/coal tar DNAPL…and are also highly leachable and mobile"* (Section 4.4.18) and further that *"DNAPL at the Site cannot be reliably contained because any vertical barrier/treatment wall that would be installed at the Site could only be a 'hanging' wall"* (Executive Summary, page ES-7).

  These statements are not consistent with information contained in the Remedial Investigation and fail to recognize that the mobility of Site DNAPL varies depending on the DNAPL's characteristics and its location. Many DNAPL occurrences are in thin stringers, below residual saturation, and/or highly weathered and do not require complete physical barriers for reliable containment. EPA is correct that a vertical barrier/treatment wall would be 'hanging' but the EPA has approved these types of walls at other Superfund sites where DNAPL is left in place (e.g., McCormick & Baxter and PSR).

- **DNAPL Impacts to Groundwater.** The EPA assumes all Site DNAPL is a significant contributor to groundwater contamination, even though this depends on localized geology and DNAPL characteristics, which vary across the Site. Some DNAPL areas do not result in significant groundwater impacts (e.g., north of the Still House).

- **Ability to Limit Dredging Residuals.** In disapproving Section 7, the EPA indicates the information on dredging residuals is dated and results in biased evaluations; however, the EPA does not reference more recent applicable (i.e., DNAPL) case studies. While there have been advances in dredging and release control technologies (such as the proposed use of the SedVac dredging technology to improve control of releases), the references cited are considered current standards in the industry and we are not aware that there has been a widespread rethinking regarding the ability to limit dredging residuals.

- **Effectiveness of Amended and Reactive Core Mat (RCM) Caps.** The EPA rates the implementability of alternatives with Amended and RCM caps as either medium or low and indicates there is little field experience and high uncertainty in long-term effectiveness and O&M requirements for such caps. This analysis fails to recognize: 1) the number of successful case studies, including at Superfund sites, where such caps have been implemented (12 of which are identified in Appendix C of the FS); 2) RCMs were specifically developed to improve the field installation and potential replacement procedures for amended caps; and 3) the ability during design to complete a more detailed evaluation of options that could incorporate either RCMs or thicker amended caps. Note that the FS included an amended cap option, but the EPA removed that option, even though it stated that it viewed amended caps as more reliable.

Proposed Next Steps

In summary, the Respondents disagree with many of the EPA's comments on and revisions to the draft final FS. Based on the significance of the issues outlined above and the effect on remedy selection, the Respondents cannot represent that the EPA's rewrite is the Respondent's submittal to the EPA. We are committed to working with Region 10 to resolve these issues in a timely manner in compliance with the AOC and see value, given the emphasis that the EPA is placing on the groundwater model results for decision-making, in collecting additional data to help refine the groundwater model. We believe that refinement of the model may have a significant impact on the evaluation of the FS alternatives. We have a meeting scheduled with the EPA on November 20th to discuss the process for revising and finalizing the FS. We respectfully request that the deadline for submitting the revised final FS be extended to 60 days after that meeting.

Please let me know if you have any questions or wish to discuss further.

Sincerely,

Aspect consulting, LLC

Timothy J. Flynn

Tim Flynn, LHG, CGWP
Principal Hydrogeologist

cc: Cami Grandinetti, EPA
Shawn Blocker, EPA
Ted Yackulic, EPA
RueAnn Thomas, Nattura Group
Lynn Manolopoulos, Davis Wright Tremaine
Jim Hanken, Wolfstone, Panchot and Bloch
Robert Cugini, Altino Properties
Jeremy Porter, Aspect Consulting, LLC
Barry Kellems, Integral Consulting
Susan Moore, CH2M HILL

V:\020027 Quendall Terminals\Letter to EPA re draft final FS\Letter to EPA re Quendall Draft Final FS comments_10302014.docx

ATTACHMENT D

Preliminary Response to EPA Comments on the Draft Final Feasibility Study. Letter to Lynda Priddy, EPA, November 14, 2014

November 14, 2014

Lynda Priddy
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900, M/S ECL-115
Seattle, Washington 98101-3140

Re: Preliminary Response to EPA Comments on the Draft Final Feasibility Study
Quendall Terminals Superfund Site, Renton, Washington
Docket No.: CERCLA-10-2006-0325

Dear Ms. Priddy:

The Respondents reviewed the EPA's comments on the Draft Final Feasibility Study (DFFS) and in a letter dated October 30, 2014 summarized some of our key policy and technical concerns with the comments. That letter also discussed the potential value of collecting additional data to help refine the groundwater model before finalizing the DFFS. In your email dated November 10, 2014, you asked Respondents to provide additional responses to the EPA's comments and more details on the potential future work prior to the meeting, which is scheduled for November 21, 2014. That information is provided below.

Preliminary Response to Comments

A preliminary response to comments is provided in the attached Table 1. This table summarizes substantive comments we have identified to date. Further review after our November 21st meeting may give rise to further comments. This preliminary response focuses on significant concerns that we believe warrant discussion. We have not yet conducted a technical edit of the EPA's revisions so this response does not address grammatical and other non-substantive comments.

There are a number of concerns identified that occur multiple places in the document. For example, statements in the Executive Summary also occur in subsequent Sections. To reduce repetition, we have identified a concern only once regardless of how many times it is reflected in the document.

To focus our discussion on November 21st, we recommend prioritizing the issues identified in our October 30th letter. The issues identified in Table 1 likely warrant discussion but some may be able to be resolved outside our meeting. Priority issues for discussion may be organized as follows:

- Groundwater Restoration and Basis for a Technical Impracticability (TI) Waiver
  - The EPA's Assumptions of Model Conservativeness
  - DNAPL as a Source to Groundwater Contamination
- Role of a TI Waiver in the Overall Protectiveness Evaluation
- Principal Threat Wastes (PTWs)
  - DNAPL Characteristics for PTW Designation
  - Requirements for Treatment/Removal of PTWs

- RCM Caps
  - Potential Effectiveness
  - Design Purpose
  - Implementability
- Dredging Residuals at Coal Tar Sites

Conceptual Work Plan

As indicated in our October 30th letter, the Respondents believe additional data and modeling is warranted given the weight the EPA is giving the model results in revising the DFFS. As acknowledged by the Respondents and the EPA, the groundwater model predictions are far from certain and were designed to be conservative. The impact of this conservativism on the EPA's conclusions appears significant, and we disagree with the EPA's assumptions on how groundwater restoration might differ from model predictions. Therefore, we recommend improving the accuracy of the groundwater model through a step-wise approach of data collection and model refinement. This process would be conducted as follows:

- **Step 1. Data Collection.** The model is sensitive to initial source term concentrations. The previous model source terms considered maximum concentrations detected during the 2008/2009 RI field program. Because it has been 5 years since the last groundwater data was collected and several wells at that time exhibited substantial seasonal ranges of contaminant concentrations, we recommend resampling a subset of wells to confirm existing conditions and provide additional data in developing average source term concentrations for the model. Wells to be sampled include:
  - Wells with limited historical data (new deep wells installed during the RI): BH-5B, BH-20C, BH-25A(R);
  - Wells near the edge of contaminant plumes: BH-21B; and
  - Wells with significant seasonal variability: BH-28B.
- **Step 2. Groundwater Model Calibration.** The groundwater model will be refined to offer greater resolution and recalibrated to more closely match empirical data for benzene and benzo[a]pyrene. Proposed updates include:
  - Greater discretization of source concentrations through additional layers; and
  - Model calibration using empirical groundwater data presented in the RI and collected as described above, by adjusting dispersivity to literature values, and balancing source concentrations to minimize model bias.
- **Step 3. Uncertainty Analysis and Data Needs Evaluation.** A sensitivity analysis will be conducted with the recalibrated model to determine if additional new data (beyond resampling of existing wells) is warranted. Potential data needs may include shallow wells near potential sources to refine contribution of specific source areas and deep groundwater sampling (particularly in the eastern portion of the site or offshore area) to verify refined model predictions.

- **Step 4. Restoration Time Frame and Plume Size Calculations.** Once the model has been adjusted to better match empirical data, FS alternatives will be rerun to revise estimated plume volumes and restoration time frames for use in the revised DFFS.

We will be prepared to discuss these issues with you at the November 21st meeting.

Sincerely,

Aspect consulting, LLC

Tim Flynn, LHG, CGWP
Principal Hydrogeologist

cc: Cami Grandinetti, EPA
Shawn Blocker, EPA
Ted Yackulic, EPA
RueAnn Thomas, Nattura Group
Lynn Manolopoulos, Davis Wright Tremaine
Jim Hanken, Wolfstone, Panchot and Bloch
Robert Cugini, Altino Properties
Jeremy Porter, Aspect Consulting, LLC
Barry Kellems, Integral Consulting
Susan Moore, CH2M HILL

Attachments
Preliminary Response to EPA Comments and Section Rewrites Table

V:\020027 Quendall Terminals\Letter to EPA re draft final FS\November 2014 letter\Letter to EPA response to Quendall Draft Final FS comments_11142014.docx

PRP RESPONSE NO.	REFERENCES	EPA COMMENT/REWRITE	ISSUE/RESPONSE
1	EPA Comment Item 2.a	*EPA concluded that Alternatives 7 through 10 could satisfy the criterion, "Overall Protectiveness" because either one or more MCLs would be met throughout most of the plume, if not all of it. In cases where MCLs could not be met, a Technical Impracticability waiver would likely be granted.*	See PRP Response No. 34 (page 5 in this table) to *Page ES-12, Overall Protection of Human Health and the Environment Summary* below. Meeting the MCL ARAR or obtaining a Technical Impracticability waiver should not be a requirement for meeting the "Overall Protectiveness" criterion.
2	EPA Comment Item 2.b	*The Respondents consistently ignored acknowledging that MCLs could be met for one or more of the Indicator COCs in various locations of the groundwater plume before a 100 years passed.*	This statement is incorrect. Sections 7.9.1, 7.9.2.1, 7.11.1, 7.11.2.1, and 8.2 of the DFFS all discuss Indicator COCs that are predicted to achieve MCLs in less than 100 years. Furthermore, the reduction in area (i.e., locations where MCLs may be met) is a significant factor in the DFFS evaluation for all alternatives.
3	EPA Comment Item 2.c	***Long-term Effectiveness and Permanence.*** *The Respondents evaluation for each alternative only focused on whether source control RAOs were met or not and the mechanism for controlling contamination left in place by describing various engineering controls. There is no discussion about the potential risk of the contamination left on-site. EPA revised the discussion of this criterion in Section 7 to discuss risk by presenting quantitative measures "of the volume or concentration of contaminants in waste, media, or treatment residuals remaining on the site" in accordance with guidance.*	This statement is untrue. The DFFS provides extensive analysis of potential risk and includes consideration of not just the volume and concentration of contaminants, but also their location and risk for release or future exposure. See the detailed evaluation of each alternative (Sections 7.3.3.1, 7.4.3.1, etc.) and the comparative evaluation (Section 8.3.1) of the DFFS. The EPA's analysis treats all DNAPL as having the same residual risk. The EPA's analysis is deficient because it ignores the variability in residual risk resulting from contamination in different locations and with different mobility characteristics.
4	EPA Comment Item 3	***Biased Assessment of Remedial Technologies.*** *EPA is also disapproving Section 7 because certain aspects of the evaluation of alternatives were based on several overarching assumptions that resulted in biased evaluations.* *Respondents use the assumption that generation of residuals associated with dredging or excavation are such a disadvantage that any alternative that is removal-based cannot achieve the best balance of pros and cons to justify selection of primarily removal based alternative.*	Section 7 of the DFFS includes discussion of impacts regarding capping (Figure 7-4), describes impacts from both dredging and capping, and acknowledges that BMPs can be used to control impacts. We strongly disagree with the EPA's contention that the DFFS precludes alternatives that include source removal. Source removal, including sediment dredging, is a significant component of the remedy that Respondents proposed as having the best balance of tradeoffs (new Alternative 4a). Advances in sediment dredging technology were incorporated as described in PRP Response No. 5 to EPA Comment Item 3.a.i below. On the contrary, we believe that EPA's analysis is highly biased toward full removal/treatment alternatives without providing a technical basis for this apparent bias. Their analysis understates the potential impacts of the large-scale removals proposed in Alternatives 7 through 10 by assuming that BMPs will be adequate to mitigate all impacts, and overstates the ability to control residuals (see PRP Response No. 5 to EPA Comment Item 3.a.i below). We strongly disagree with the EPA's assumption regarding the potential for residuals, based on the subsurface complexities of the Site. The EPA's analysis of alternatives is predicated on the potential for Alternatives 7 through 10 to achieve MCLs in groundwater, but no technical justification or relevant case studies (i.e., dredging at coal tar/creosote sites) are provided.
5	EPA Comment Item 3.a.i	*The Respondents reference source information that is considered dated at this point. Since that time, there have been advances in dredging technology. In fact, some recent cleanup dredge projects have achieved cleanup numbers on dredged surfaces without incorporating the use of thin sand covers over residual contaminated surfaces.*	The DFFS alternatives include consideration of advances in technology, for example the SedVac technology for dredging DNAPL-containing sediments. This technology is more recent than the mechanical environmental bucket technology the EPA has added, and more applicable and protective for the shallow DNAPL in the TD area. We requested information from Shawn Blocker on the EPA's "recent cleanup dredge projects [that] have achieved cleanup numbers on dredged surfaces without incorporating the use of thin sand covers over residual contaminated surfaces" but no information was provided. The Boeing Plant 2 and Todd Shipyard case studies are not relevant since they did not include dredging of NAPL or, more specifically, coal tar DNAPL. Section 7.5.5.3 of the DFFS states: *Based on detailed studies performed at a range of environmental dredging sites which included silt curtains or similar technologies, approximately 2 to 4 percent of the mass of hydrophobic contaminants such as cPAHs that are dredged are released into the water column, with most of the release being in the bioavailable dissolved form (Bridges et al. 2010)*. We disagree that a 2010 reference should be considered 'dated'. Also note that EPA has deleted the above statement and replaced it with: *As discussed in Appendix C, Section C5.3.2, studies have concluded that a small percentage of the solids excavated or dredged during the last dredge production cut may accumulate as a post-dredge residual layer*. It is inconsistent to replace a water column release reference with a sediment residual reference. We disagree with this revision to the text.
6	EPA Comment Item 3.a.ii	*Respondents failed to acknowledge a number of troublesome issues about the use of capping on contaminated sediments. Aside from the fact that alternatives that rely heavily on the use of aquatic caps, in perpetuity, can be eroded or damaged will require monitoring and maintenance "forever". A cap that fails because it erodes or is damaged can release contamination for a long time before it is noticed.*	Issues related to long-term monitoring and maintenance of caps were considered in the DFFS evaluation. The EPA's added statement: *A cap that fails because it erodes or is damaged can release contamination for a long time before it is noticed* is not relevant since there is no current DNAPL seepage observed in the existing (uncapped) condition. Note that the Respondent's preferred remedy includes dredging of all shallow DNAPL and capping of areas where DNAPL is deep and isolated by existing sediment.

PRP RESPONSE NO.	REFERENCES	EPA COMMENT/REWRITE	ISSUE/RESPONSE
7	EPA Comment Item 3.a.iii	*Respondents propose the use of some recently developed technologies, amended caps and RCM caps, where there is no field data or experience regarding the long-term use and effectiveness of reactive caps. They show promise however, the many concerns about their reliability was not addressed, such as at Quendall where nearshore bathymetry must be maintained, and if a RCM cap was installed, how is it replaced or repaired without causing releases or badly damaging the habitat.*	Field data on the long-term effectiveness of RCM caps is accumulating. The EPA Region 10-approved remedy at the McCormick and Baxter site has both bulk organoclay and RCM caps spanning 23 acres that were installed in 2004. Extensive laboratory and field testing in 2006 and 2008 confirmed that both caps are performing as designed (Blischke and Olsta, 2009). These capping technologies have widespread usage, as discussed in Appendix C of the DFFS. In Section 7.5.3.2, the EPA added the statement: *Mixing reactive material with capping media is an evolving technology and is expected to be used successfully in the future*. This statement is not relevant since RCM placement without release of DNAPL has been demonstrated as described in Appendix C, and EPA Comment Item 121 indicates EPA had no comments on Appendix C. EPA's comments and text rewrites (e.g., rating implementability low for Alternative 3) expresses a bias against capping, particularly RCM caps, which is inappropriate for an FS that is intended to objectively evaluate a range of remedial options. As described above, capping has been evaluated and successfully implemented at numerous sites and should be considered a highly implementable technology.
8	EPA Comment Item 3.b	*However, as noted, residuals can be a result of dredging but Respondents cannot automatically assume that residuals will cause a failure to meet cleanup numbers with today's technology and practices. Respondents fail to pay equal attention to the problems associated with alternatives that rely on ICs, in addition to capping, for remedial protectiveness and reliability. More can be done to prevent exposure to dredge residuals than to ensure the enforcement of ICs.*	The DFFS discusses limitations due to ICs. Note that the EPA's rewrite of Section 7 acknowledges that long-term monitoring and ICs in both the upland and aquatic areas will be needed in perpetuity to ensure effectiveness for Alternatives 7 through 10 (see Section 7.9.4.3). Yet the EPA's analysis is heavily biased against Alternatives 2 through 6 based on the EPA's perception of the uncertainty in enforcing and maintaining ICs, even though all ICs discussed have been commonly implemented at similar sites.
9	EPA Comment Item 4	***EPA Disapproves Section 8 of the Draft FS.*** *EPA is disapproving Section 8 of Respondents' draft final FS, dated October 14, 2013. Section 8 of the FS is deficient. The Respondents' comparative evaluation is based on the evaluation of individual alternatives in Section 7. Unfortunately, because Section 7 is not consistent with the NCP and RI/FS guidance in the way in which many of the NCP 9 Criteria are meant to be applied, or the evaluation is incomplete, Section 8 does not contain justifiable results from the comparative analysis using the NCP's 9 Criteria.*	As discussed in other comment responses, we disagree with the EPA's contention that Section 7 of the DFFS is inconsistent with the NCP and RI/FS guidance. We also disagree with the EPA's characterization of Section 8 of the DFFS as deficient. The primary substantive change in the EPA's rewrite of Section 8 is deletion of the comparative analysis for Alternatives 2 through 6 on the basis that these alternatives would not qualify for a TI Waiver (a premature consideration at the FS-stage of the remedy selection process).
10	EPA Comment Item 6	*EPA stated several times that the Respondents should provide the same information for Alternative 4a as they provided to EPA for the other alternatives. EPA never received a complete set of information for Alternative 4a.*	Relevant information for Alternative 4a was provided in Aspect's March 14, 2014 technical memorandum re: Proposed Preferred Remedy at the Site.
11	EPA Comment Item 7	*The Habitat Area shall not contain a PRB or collection trenches or other remedial technology without the permission of EPA, the Muckleshoot Tribes and Trustees. These technologies are incompatible with the purpose of the Habitat Area and cannot be maintained or replaced without significant damage to the Habitat Area.*	As previously directed by the EPA, the DFFS assumes that PRB/trenches are not located in habitat area. However, we disagree with the EPA's statement that all remedial technologies are incompatible with the habitat area. Compatibility should be evaluated on a case-by-case basis during remedial design. Categorically excluding remedial components in the habitat area without detailed evaluation of compatibility limits the effectiveness and potential benefits of certain remedial technologies.
12	EPA Comment Item 8	*EPA has determined that the Renton SMP is not an ARAR.*	We strongly disagree and have explained the basis of our objection to the EPA's ARAR determination in Respondent's letter to Lynda Priddy of the EPA regarding Dispute Resolution – Comment on Draft Final FS, dated November 6, 2014.
13	EPA Comment Item 9	***Risk-based PRGs at 10^{-6}.*** *EPA has identified risk-based PRGs at a risk level of 10^{-6} in the Draft Final FS. The exception is naphthalene in groundwater, where a RBC of 1.4 ug/L based on a risk level of 10^{-5} is used, for reasons provided in the text.*	The EPA has not provided any basis for changing the risk level from 10^{-5} to 10^{-6} for identifying PRGs (for purposes of the DFFS)
14	EPA Comment Item 10	The Respondents cannot make claims that impermeable caps associated with future development can impact DNAPL mobility, etc., with the implication that it would aid remediation unless the Respondents want to install an impermeable cap during remedial action. Otherwise, the occurrence of an impermeable cap is speculation.	Evaluation of DFFS alternatives assume permeable caps. However, because impermeable caps are a possible component of future development, it is important to state how such a cap would affect the remedy. Impermeable caps are expected to be compatible with the chosen remedy because, if anything, leaching would be reduced as stated in the DFFS. It is unclear why the EPA wants to remove this evaluation when it addresses a potential future

PRP RESPONSE NO.	REFERENCES	EPA COMMENT/REWRITE	ISSUE/RESPONSE
			change of Site conditions. Furthermore, EPA previously agreed to include impermeable caps in the groundwater model because of the likelihood that such a cap will be installed in the future.
15	EPA Comment Item 11	The type of thermal treatment will be determined in RD. The term “thermal desorption” was often used and not well-defined. Thermal desorption can refer to a number of different thermal treatment systems, especially when the temperature range is not specified, or whether an afterburner is coupled with the treatment system. Therefore, the term “thermal desorption” is replaced by the term “thermal treatment”.	Thermal desorption is well defined in Section 5.3.2.5. Thermal treatment is used in the DFFS as a more general term that includes vitrification and incineration. Replacing thermal desorption with thermal treatment adds confusion.
16	EPA Comment Item 12	*RCM Caps. EPA has a number of concerns regarding the use of RCM caps. There is little, if any field data, on the service life of reactive materials as used in various technologies. Analytical calculations are used to “estimate” the service life or replacement rate of reactive materials. Additionally, the replacement process has not been described and the impacts associated with removing or adding additional material when needed. The obstacles to be encountered at Quendall when placing or removing RCM caps has not fully been addressed. The placement of a RCM could be compromised by the extensive amount of wood debris in or on the Quendall sediments. These issues have not been discussed sufficiently in the FS, especially in the evaluation of alternatives.*	See PRP Response No. 7 to EPA Comment Item 3.a.iii. EPA Comment Item 121 indicates that EPA had no comments on Appendix C. The issues identified in this comment related to debris or replacement could be addressed in the FS and do not provide a basis for eliminating an organoclay RCM cap. A debris survey and removal of large debris would likely be part of the sediment remedy whether dredging or capping is selected. Typically, these caps are designed with a large factor of safety that minimizes the frequency and need for replacement. More Site-specific data could be collected to support a Site-specific application. The EPA-approved West Branch of the Grand Calumet River project includes a 6-inch organo-clay cap with an estimated design life of 420 years.
17	EPA Comment Item 13	***One Process Option.*** *EPA does not see a reason to include more than one process option in a given alternative (e.g., amended sand cap and RCM cap), as that decision can be considered during remedial design. EPA eliminated the amended sand cap and used the RCM cap as the representative process option.*	In the EPA's rewrite, the EPA states that amended caps are more reliable and have fewer concerns for implementability, maintenance, and replacement than RCMs (Section 7.3.6.1). It is unclear why the EPA chose to retain the process option they perceive as less reliable. The EPA's comments and text rewrite expresses a bias against capping that is inappropriate for an FS, which is intended to objectively evaluate a range of remedial options.
18	EPA Comment Item 14	*ENR Area. EPA changed the ENR area to be determined as twice the BTV rather than 8 times the BTV.*	What is the basis for 2X the BTV? No basis has been provided in the comments or in the revised text.
19	EPA Comment Item 20	*Add an additional bullet (after the North and South Sump bullet): “Quendall Pond, located near the shoreline, was constructed in an area where tank bottoms from nearby storage tanks were placed. This area also received wastes from North Sump overflows. Waste from Quendall Pond has migrated into adjacent Lake Washington.”*	This text revision is misleading. We are not aware of any waste (e.g. DNAPL) from Quendall Pond migrating into Lake Washington. Suggested edit to last sentence: *DNAPL from Quendall Pond has migrated into **sediments beneath** Lake Washington.*
20	EPA Comment Item 26	*Replace last two sentences “However, four samples…” with: “There are a few instances of very low detections of benzo(a)pyrene above the MCL in areas outside of the DNAPL “footprint”, but they are either bordering on the footprint (2 µg/L in BH-12 and 2.3 µg/L at BH-18A) or are at concentrations very close to the MCL (0.24 µg/L at BH-29A and 0.23 µg/L at WP-4).”*	The new sentences should be added without the indicated deletion. Soil data are relevant to evaluating the distribution of cPAHs in groundwater in areas where the soil data provide better resolution than the available groundwater data. The soil data are important in the evaluation of the restoration time frame for benzo[a]pyrene.
21	EPA Comment Item 45	*Delete: “Although implementation of low permeability and impervious caps are relatively more expensive then permeable caps, they may be appropriate in portions of the Site or for some future Site uses, and can be more effective than permeable caps by preventing infiltration and reducing leaching of contaminants. Permeable caps may be more cost-effective to protect against direct contact with contaminated soil in areas where leaching is not a concern.”*	We disagree with this deletion. See PRP Response No. 14 to EPA Comment Item 10.
22	EPA Comment Item 46	*Revise to: “In situ solidification/stabilization described in Section 5.3.1.3 for DNAPL is applicable and effective for immobilizing Site COCs in soil as it is the most common remedial technology used at creosote/coal tar Superfund Sites.”*	What is the authority for the statement that *in situ* solidification/stabilization is the most common remedial technology used at creosote/coal tar Superfund Sites?
23	EPA Comment Item 47	*Delete “Biodegradation is ongoing at the Site”.*	We disagree with this deletion. In describing the potential effectiveness of bioremediation, it is important to note that biodegradation is an ongoing process at the Site. Bioremediation is less effective at sites where natural biodegradation does not occur.

PRP RESPONSE NO.	REFERENCES	EPA COMMENT/REWRITE	ISSUE/RESPONSE
24	EPA Comment Item 57	*Revise to: "Environmental buckets vary in size and can be retrofitted to address different degrees of sediment hardness. For example, at the Todd Shipyard Sediment Operable Unit at Harbor Island (Todd), large steel plates were soldered to the sides of an environmental bucket to provide more weight for penetrating sediments. Appropriately large environmental buckets can be used to handle debris. For example, at Todd large and cumbersome shipyard debris was successfully removed (see Figure 5-1)."* *Create a new Figure 5-1 with the figure provided at the end of this comment chart. Caption the figure: "Environmental Dredge Bucket Used at Todd Shipyard, Harbor Island, Washington."*	See PRP Response No. 5 to EPA Comment Item 3.a.i.
25	EPA Comment Item 58	*Revise to: "However, many of these effects are reduced due to recent innovations, increased operator expertise, use of containment (e.g., sheet piles, silt curtains, booms), best management practices (BMPs) (e.g., production rates, bucket control, etc.), and/or by equipment selection. Recent dredging events at the Boeing facility on the Duwamish River were accomplished without exceedances of sediment cleanup numbers."*	We disagree with this revision because it fails to consider the presence of DNAPL. Recent innovations have reduced the 4R's (resuspension, release, residual, and risk) related to solid-phase contaminants, but do not completely address potential effects due to dredging sediments with DNAPL. The EPA's proposed revision is not adequately considering the complexity of the DNAPL source distribution and subsurface heterogeneity at the Site.
26	EPA Comment Item 60	*Revise to: "Thermal desorption of sediments may be less effective than for soils due to the higher moisture content of sediment and typically requires dewatering of sediments prior to treatment. For the purpose of the FS, the term "thermal treatment" will be used, as the specifications for the treated material and emission standards will be determined during remedial design."*	See PRP Response No. 15 to EPA Comment Item 11.
27	EPA Comment Item 80	*Use Table 8-2 as a basis and update as follows:* *1. Remove "Containment with" from the names of Alternatives 3 through 10.* *2. Overall Protection of Human Health and the Environment: For Alternatives 1 through 6, "No". For Alternatives 7 through 10: "Yes".* *3. Complies with ARARs: For Alternatives 1 through 6, "No" with a footnote stating "A TI Waiver would not be granted because PTW is readily accessible and removal or treatment is feasible with currently available engineering technology." For Alternatives 7 through 10, "Yes" with a footnote stating "It is assumed that a TI waiver would be granted if monitoring data indicate that MCLs may not be met, since all known PTWs would be addressed under this alternative."* *4. For balancing criteria, update with ratings from the text of Section 7.*	For 2&3 - See PRP Response No. 1 to EPA Comment Item 2.a above and PRP Response No. 34 to *Page ES-12, Overall Protection of Human Health and the Environment Summary* below. For 4 - There are inconsistencies in the text of Section 7 on ratings. Alternative 4 is rated low for long-term effectiveness in Section 7.5.3.3 and moderate in Section 7.5.1.3. Alternative 7 is rated low for short-term effectiveness in Section 7.5.1.3 and moderate in Section 7.5.5.5.
28	EPA Comment Item 82	*Duplicate new Table 7-3 and revise as follows:* *1. For Alternatives 1 through 6, replace symbols for the balancing criteria with dashes.* *2. Add footnote to the Overall Protectiveness of Human Health and the Environment criterion for Alternatives 1 through 6 stating "Because this alternative does not satisfy the Threshold Criteria, it is not carried forward in the Balancing Criteria comparison."*	See PRP Response No. 34 to reference *Page ES-12, Overall Protection of Human Health and the Environment Summary* below.
29	EPA Comment Item 123	*Costs for dredging BMPs could lead to a significant increase in per-cubic-yard cost for dredging. Respondents should describe how these are represented in the 25% contingency. (Comment from Draft FS, not addressed.)*	Need to clarify to which BMPs the EPA is referring. The sediment environmental controls and sheet pile enclosure costs are explicitly included in the cost estimate and are not built into the dredging unit cost or covered entirely in the contingency.
30	Page ES-2, *Site Description and Source Area*	*Waste from Quendall Pond has migrated into adjacent Lake Washington.*	See PRP Response No. 19 to EPA Comment Item 20.

PRP RESPONSE NO.	REFERENCES	EPA COMMENT/REWRITE	ISSUE/RESPONSE
31	Page ES-7, *Site Areas and Media Targeted for Remedial Action* Also Section 4.4.1.8	*DNAPL at the Site cannot be reliably contained because any vertical barrier/treatment wall that would be installed at the Site could only be a "hanging" wall. There is no aquitard in which to anchor a barrier/treatment wall.*	The EPA's characterization that there is "no aquitard" is misleading when used in this context. The shallow alluvium contains laterally extensive low permeability peat deposits that in the aggregate limit the downward migration of DNAPL at the Site. A complete physical barrier (sides and bottom) is not needed to reliably contain all Site DNAPL. DNAPL present as oil-coated soil is not mobile. There is a finite source, and even if DNAPL present as oil-wetted soil were disturbed by future earthquakes, etc., most could not move beyond the Site boundaries. DNAPL containment strategies implemented at other CERCLA sites include hanging walls (e.g., McCormick and Baxter, PSR).
32	Page ES-12, *RAOs for Protection of Human Health*	*Alternatives 7 through 10 treat or remove all known PTWs and, therefore, may restore groundwater to meet drinking water standards for one or more COCs throughout most of the plume, if not all of the plume. For these alternatives, institutional controls that specifically address use of drinking water would not be fully required in perpetuity.*	We disagree with this point and the EPA does not provide a technical basis for these statements. Leaching from the solidified mass would likely require ICs for drinking water in perpetuity.
33	Page ES-12, *RAOs for Protection of Human Health*	*…whereas a soil cap may not be needed for Alternatives 7 through 10, where all PTWs are removed or treated.*	Alternatives 7 through 10 leave contaminated soil (not DNAPL) in place that exceeds PRGs, and a soil cap would still be needed.
34	Page ES-12, *Overall Protection of Human Health and the Environment Summary* Also Sections 7.3.1.3, 7.4.1.3, 7.5.1.3, 7.6.1.3, 7.7.1.3, and 7.8.1.3.	*Alternatives 2 through 6 would not meet [the threshold criterion Overall Protection of Human Health and the Environment.]*	It is unclear whether the EPA is claiming that Alternatives 2 through 6 would not meet this criterion due solely to the ARAR compliance issue, or whether the long-term effectiveness and permanence of these alternatives is also judged to be inadequate. The NCP states (*40CFR 300.430(e)(9)(iii)(A))*: *Overall protection of human health and the environment. Alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals consistent with § 300.430(e)(2)(I). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.* The analysis must <u>draw on</u> the assessment of other criteria. The fundamental question is whether exposures are controlled in the short-and long-term. Since ICs can be used to control exposure to groundwater exceeding MCLs, protection is achieved. In addition, the EPA determines that leaving untreated DNAPL on site results in an unacceptable risk, but does not provide its rationale. Region 10's interpretation essentially precludes consideration of containment of DNAPL as a component of any remedial action at the Site. This is inconsistent with the EPA's policy on PTW and how it has been applied at other Superfund sites involving DNAPL.
35	Page ES-13, *Overall Protection of Human Health and the Environment Summary*	*Alternatives 7 through 10 would meet [the threshold criterion Overall Protection of Human Health and the Environment] because all known PTWs are removed or treated. They would also likely comply with the MCL ARAR…*	The linkage between PTW removal/treatment and meeting overall protectiveness is not clear. The statement that Alternatives 7 through 10 would <u>likely</u> comply with the MCL ARAR is not supported. Also, in a footnote the EPA states that some DNAPL *could be inadvertently missed during remedial implementation.* Is the EPA confident that this residual DNAPL is unlikely to significantly impact groundwater quality?
36	Page ES-13, *Compliance with the MCL ARAR*	*Benzene was predicted to exceed its MCL after 100 years for Alternatives 1 through 7 and 9. It was predicted to achieve its MCL after 28 years for Alternative 8, and after 14 years for Alternative 10. EPA believes that the timeframes for Alternatives 8 and 10 may also be relevant for Alternatives 7 and 9, given that the extent of benzene MCL exceedances based on empirical data are smaller than the model predicts, in situ solidification is likely to oxygenate the subsurface and aid in volatile attenuation, and the resulting solidified materials are not considered to be aquifer materials.*	The third point (solidified materials are not aquifer materials) is already accounted for in the groundwater model. The assumption that oxygen added during solidification will greatly reduce restoration time frame is not supported by any data; rather, similar remediation techniques (oxygen-release compounds) are not effective given the mass of contaminants found in DNAPL. Finally, the groundwater model over-prediction of the benzene plume extent has nothing to do with estimated restoration time frame under solidification scenarios. The solidified mass acts as an on-going source in perpetuity. It is unclear how the EPA can, on this basis, conclude that these very different alternatives may have similar restoration time frames.
37	Page ES-13, *Compliance with the MCL ARAR*	*The reason the groundwater model predicts MCL exceedances after 100 years for Alternatives 7, 8, and 9 is that it assumes a baseline condition in where benzo(a)pyrene exceeds the MCL outside of the DNAPL areas; therefore, even when the DNAPL source is removed, the model assumes that the MCL exceedances remain and do not degrade over time.*	This is incorrect – the groundwater model <u>does</u> assume that residual BaP degrades over time; it just takes >100 years to achieve the MCL.

PRP RESPONSE NO.	REFERENCES	EPA COMMENT/REWRITE	ISSUE/RESPONSE
38	Page ES-14, *Compliance with the MCL ARAR*	*For Alternatives 7 through 10, EPA believes that if the known DNAPL source is removed or treated, arsenic will also be more significantly reduced than the modeling predicts.*	We disagree with this point and the EPA does not provide any authority for this statement.
39	*Section 4.4* • *DNAPL Cumulative Thickness.*	Greater cumulative thicknesses of DNAPL (either oil-coated or oil-wetted) can contribute more significantly to groundwater contamination. Further, DNAPL residuals present as thin stringers have more surface area per volume of DNAPL; therefore, cumulative thicknesses that comprise multiple layers may impact groundwater as much or more significantly than contiguous DNAPL occurrences.	We disagree with and this point and the EPA does not provide any authority for this statement. Contribution to groundwater depends also on geology, groundwater occurrence, and DNAPL leaching characteristics/weathering. The Site area with the greatest cumulative thicknesses (North Sump) has relatively modest contaminant concentrations in groundwater.
40	*Section 4.4.1.1 Railroad DNAPL Area (RR DNAPL Area)*	Boring BH-30C is also the only location at the Site where DNAPL has been observed in the transition zone between the Shallow Alluvium and Deep Alluvium.	What is the "transition zone"? The RI does not refer to a transition zone and there does not appear to be any basis for labeling the area between the Shallow and Deep Alluvium as a transition zone.
41	*Section 4.4.1.8 Key Factors Influencing DNAPL Remediation*	EPA has determined that DNAPL at the Quendall Site, whether in soils or sediments, is to be considered as PTW because of the high level of toxicity inherent in the creosote/coal tar DNAPL. Creosote/coal tar contaminants present in DNAPL (benzene and naphthalene) are also highly leachable and mobile via groundwater, and DNAPL classified as oil-wetted may also be mobile. DNAPL at the Site cannot be reliably contained because any vertical barrier/treatment wall that would be installed at the Site could only be a 'hanging" wall. There is no aquitard in which to anchor a barrier/treatment wall. DNAPL is accessible. The majority of DNAPL in the uplands is found within the top 20 feet of the Shallow Aquifer with two exceptions (RR Area and Former May Creek Channel).	Some Site DNAPL has lower mobility, lower leachability, and/or lower toxicity and should not be classified as principal threat waste. Lower mobility DNAPL at other CERCLA sites (e.g., Utah Power and Light) has been characterized as low-level threat waste. We believe this same designation is appropriate for portions of the DNAPL source at the Site. The EPA has provided no basis for designating all of the DNAPL as PTW. See PRP Response No. 31 to Page ES-7, Site Areas and Media Targeted for Remedial Action above. Sediment DNAPL is located in layers as deep as 16 feet below mudline, which provides severe technical challenges for removal.
42	*Section 6.3.4.5 (for example)*	An engineered sand cap would be placed over sediments where porewater data exceeds cleanup numbers…	What are 'cleanup numbers'?
43	*Section 7.1.1.1 Overall Protection of Human Health and the Environment*	In the detailed evaluation of each alternative, the Overall Protectiveness criterion will be rated as "No", or "Yes", based on consideration of whether: 1) all exposure pathways are mitigated; 2) the alternative has long-term effectiveness and permanence; 3) does not pose a high short-term risk; and 4) meets ARARs or is waived from the requirement for compliance with an ARAR.	See PR Response No .34, to *Page ES-12, Overall Protection of Human Health and the Environment Summary* above.

PRP RESPONSE NO.	REFERENCES	EPA COMMENT/REWRITE	ISSUE/RESPONSE
44	*Section 7.1.1.2 Compliance with ARARs*	• *Because the baseline-generated plumes are larger than empirically determined plumes, the predicted model outcomes (restoration time frames and resultant plume sizes) are also likely to be "larger" than actual outcomes. This infers the following:* • *Model-estimated restoration time frames are longer than the actual time frames would be.* • *Model-estimated plume volumes (based on incremental removal of source) are larger than the actual plume volumes would be.* • *This is especially important for Alternatives where all source materials are treated or removed (Alternatives 7 through 10).* ◆ *For benzene and naphthalene, the remaining contaminant mass will flushed and the mass and thus groundwater concentrations of these COCs would decay over time based on their half-lives.* ◆ *For benzo(a)pyrene, empirical data indicate a close association of MCL exceedances with the occurrence of DNAPL. The model baseline condition plume for benzo(a)pyrene includes areas outside of the DNAPL footprint with MCL exceedances, while empirical data show no exceedances.*[1] *Therefore, the model results show that, if the DNAPL source is removed, then there are still areas of the Site with MCL exceedances that would not significantly degrade overtime. Based on empirical data, if the DNAPL source is removed, then the benzo(a)pyrene plume should also be fully addressed.* ◆ *For arsenic, treatment or removal of the DNAPL source is anticipated to affect a change in the subsurface reducing conditions that have enhanced arsenic mobility.* [1] *Note that there are a few instances of very low detections of benzo[a]pyrene above the MCL in areas outside the current DNAPL "footprint." In most cases, they are immediately outside the footprint or only marginally above the MCL (0.24 micrograms per liter in BH-29A, compared with the MCL of 0.2 micrograms per liter).*	The EPA's inference is flawed. The groundwater model assumptions that lead to over-predictions of plume size do not necessarily over-predict restoration time frame. Leaching from the solidified block would create a 'halo' (acknowledged by the EPA in the subsequent paragraph) that would remain in perpetuity and not be 'flushed out' as indicated by the EPA. Also, as the EPA acknowledges, benzo[a]pyrene is present in groundwater above MCLs outside the area of DNAPL. Benzo[a]pyrene is also present in soil outside the area of DNAPL at concentrations that leach to groundwater resulting in concentrations above MCLs. Because of the recalcitrant nature of benzo[a]pyrene, concentrations above MCLs would persist very long after source treatment. See also PRP Response No. 37 to *Page ES-13, Compliance with the MCL ARAR* above.
44	*Section 7.1.1.2* • *Residuals from in situ solidification.*	*It is expected that there will be a "halo" around the solidified area(s). The mobile benzene and naphthalene that leaches from the block(s) will be undergo degradation and will be dispersed and diluted in the groundwater. Because benzo(a)pyrene is essentially immobile, it will not likely leach from the block(s) or leach only a de minimis amount. EPA does not considered the solidified block as aquifer material; however the model assumes no change in groundwater concentrations in the block as a result of the solidification. This assumption most likely yields greatly over-stated initial post-remediation COC concentrations within the solidified areas and therefore greatly over-stated mass flux estimates that contribute to downgradient MCL exceedances and longer restoration timeframes.*	While the solidified block may not be considered by the EPA as "aquifer material", it nonetheless is saturated with contaminated porewater in contact with DNAPL. The groundwater model correctly reflects this condition. The EPA does not provide any explanation as to why or authority to support its statement that groundwater in intimate contact with DNAPL within the solidified block would have lower COC concentrations than present groundwater conditions.

PRP RESPONSE NO.	REFERENCES	EPA COMMENT/REWRITE	ISSUE/RESPONSE
45	*Section 7.1.1.2* • *Residuals from potentially not addressing every occurrence of DNAPL.*	• *Although the lateral and vertical extent of PTW remediation in both the upland and aquatic areas of the Site will be based on a field performance standard (to be determined during remedial design), small volumes and masses of DNAPL residuals could be inadvertently missed during remedy implementation. DNAPL residuals would most likely be in very thin laterally discontinuous sand stringers within the Shallow Aquifer bounded by relatively impermeable silts/clay making them very low strength groundwater contamination sources. Naphthalene and benzene mass and thus groundwater concentrations would decay over time based on their half-lives. Benzo(a)pyrene would essentially not decay and would remain essentially immobile and not significantly contribute to dissolved groundwater contamination.* *It is expected that best management practices would be used during remedy construction to address these issues related to residuals.*	Given the complex distribution of DNAPL at the Site, we agree that it is highly likely that DNAPL residuals will result under any alternative. While we believe that portions of the DNAPL source can be reliably contained, even small amounts of DNAPL remaining will persist and contribute to localized groundwater contamination in perpetuity. EPA states that it expects that BMPs will address these occurrences but provides no information on the BMPs to be used or to what degree they would address residuals. Regardless of the BMPs used during the remedy, residuals will remain and will be a source to contamination to groundwater in perpetuity.
46	*Section 7.3.3.2 Adequacy and Reliability of Controls*	***RCM Caps.*** *The adequacy and reliability of RCM caps is difficult to predict because the technology is relatively new. There is little field information about long-term effectiveness and reliability of RCM caps. There is no field information about how RCM placement and replacement/repair may affect the long-term viability of the RCM caps. The lack of long-term field experience and the need for treatability/pilot studies is a significant concern about the reliability of a technology that will be required in perpetuity. There is considerable debris on and in the surface sediments at Quendall that may cause problems with RCM integrity unless the sediment is sufficiently cleared of debris. The shoreline bathymetry would be required to be maintained, which may limit repair and replacement options. RCM caps may lose their effectiveness when the reactive material becomes saturated or damaged.*	See PRP Response Nos. 7 and 16 to EPA Comment Items 3.a.iii and 12.
47	*Section 7.3.6.1 Technical Feasibility*	*There is little field experience with the general use of RCM caps and especially, there is no field information/experience regarding the long-term use and long-term efficacy of RCM caps. There is no information about the expected longevity of RCM caps nor is there much experience with repairing/replacing RCMs when they become ineffective. Unusual technical challenges are expected when RCM caps are placed and repaired or replaced in the aquatic environment because they have only been in use for a short period of time*	See PRP Response Nos. 7 and 16 to EPA Comment Items 3.a.iii and 12.
48	*Section 7, General*	Balancing Criteria Ratings	We disagree with the rating of alternatives that the EPA has assigned for the following NCP criteria: 'Low' for Long-Term Effectiveness of Alternatives 4 and 4a. 'Low' for Implementability of Alternative 3. 'Moderate' for Short-term effectiveness and Implementability of Alternative 4a. 'Moderate' for short-term effectiveness of Alternative 7. 'High' for implementability of Alternative 7.

V:\020027 Quendall Terminals\Letter to EPA re draft final FS\November 2014 letter\Issues Table_14Nov14.docx

ATTACHMENT E

Review Comments and Responses,

Draft Final Feasibility Study, November 6, 2015

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
1	Disapproval of Section 7	**EPA Disapproves Section 7 of the Draft FS.** EPA is disapproving Section 7 of the Respondents' draft final FS, dated October 14, 2013 for the reasons described in Items 2 and 3, below.			Per August 27, 2015 meeting, EPA has revised this comment to be 'approved with comments'. The Final FS incorporates EPA's October 2014 version of Section 7 with revisions based on subsequent discussions with EPA and as noted below.
2	Disapproval of Section 7	**Failure to evaluate individual alternatives appropriately and according to EPA NCP rules and RI/FS guidance.** For example: a) **Overall Protection of Human Health and the Environment.** This evaluation criterion provides a final check to assess whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. i. The Respondents failed to completely consider all aspects of the criterion "Overall Protectiveness…" as described in the NCP and EPA guidance. The Respondents only evaluated whether an alternative met each RAO and neglected considering long-term and short-term effectiveness and whether all ARARs were met or not. EPA, by including these other factors into the evaluation of Overall Protectiveness, the Agency determined that Alternatives 1 through 6 cannot satisfy the criterion "Overall Protectiveness of Human Health and the Environment". Additionally, **EPA concluded that Alternatives 7 through 10 could satisfy the criterion, "Overall Protectiveness" because either one or more MCLs would be met throughout most of the plume, if not all of it. In cases where MCLs could not be met, a Technical Impracticability waiver would likely be granted.** b. **Compliance with ARARs.** The criterion to comply with ARARs or obtain a waiver should be individually evaluated for each alternative and also addressed in the comparative evaluation of alternatives in the appropriate locations sin the discussions. i. **The Respondents consistently ignored acknowledging that MCLs could be met for one or more of the Indicator COCs in various locations of the groundwater plume before a 100 years passed.** EPA has explained a number of times, compliance with ARARs is made on a COC basis by media and to the extent practicable. The Respondents own modeling results indicate that Alternatives 8 and 10 could result in restoration of	RE: EPA Comment Item 2.a See PRP Response No. 34 (page 29 in this table) to *Page ES-12, Overall Protection of Human Health and the Environment Summary* below. Meeting the MCL ARAR or obtaining a Technical Impracticability waiver should not be a requirement for meeting the "Overall Protectiveness" criterion.	RE: EPA Comment Item 2.a In the December 3, 2014 meeting, EPA agreed to provide an additional response regarding this issue. This response is intended to cover this issue and the Respondents' other comments related to evaluation of the alternatives against the threshold criteria. Upon further review, EPA agrees that all of the proposed alternatives (except Alternative 1) would satisfy the criterion for "Overall Protectiveness". As such, all alternatives will be included in the comparative analysis. Meeting the MCL ARAR may be assessed similarly to what was presented in the DFFS, emphasizing that alternatives that treat or remove all known PTWs have significantly greater effect on plume reduction than those that leave known quantities of PTW behind. Statements regarding whether or not a TI waiver would likely be granted may be removed. EPA will require that the Respondents provide a pre-final review copy of the FS that contains Section 1 through 7	RE: EPA Comment Item 2.a Alternatives 2 through 6 have been identified as satisfying the overall protectiveness criterion and have been included in the comparative analysis in Section 8. The discussions of meeting the MCL ARAR include the relative effect of each remedy on plume reduction. Statements regarding the likelihood of obtaining a TI waiver have been removed. As identified in EPA's letter dated September 28, 2015, the pre-final review copy of the FS submitted to EPA includes Sections 1 through 8.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
		groundwater to the MCL for benzene. Additionally, the Respondents results also show that the plume exceeding MCLs can be dramatically reduced by Alternatives 7 through 10 and for the portions of groundwater that exceeded MCLs, a TI waiver could be granted. A TI waiver and/or compliance with MCLs would be sufficient to fully comply with the threshold criteria regarding compliance with ARARs. c. **Long-term Effectiveness and Permanence.** The RI/FS Guidance states "(t)he primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The following components of the criterion should be addressed for each alternative: i. Magnitude or residual risk – This factor assesses the residual risk remaining from untreated waste or treatment residuals at the conclusion of remedial activities…" ii. Adequacy and reliability of controls – "(t)his factor assesses the adequacy and suitability of controls, if any, that are used to manage treatment residuals or untreated wastes that remain at the site." **The Respondents evaluation for each alternative only focused on whether source control RAOs were met or not and the mechanism for controlling contamination left in place by describing various engineering controls. There is no discussion about the potential risk of the contamination left on-site. EPA revised the discussion of this criterion in Section 7 to discuss risk by presenting quantitative measures "of the volume or concentration of contaminants in waste, media, or treatment residuals remaining on the site" in accordance with guidance.** Additionally, the Respondents discussion of controls was superficial, lacking in any specifics such as the fact that ICs aimed at protecting aquatic remedial actions are unenforceable or that there is little information and field experience regarding the long-term effectiveness of RCM caps.		of the text prior to submittal of Section 8 (Comparative Analysis of Alternatives).	
			RE: EPA Comment Item 2.b This statement is incorrect. Sections 7.9.1, 7.9.2.1, 7.11.1, 7.11.2.1, and 8.2 of the DFFS all discuss Indicator COCs that are predicted to achieve MCLs in less than 100 years. Furthermore, the reduction in area (i.e., locations where MCLs may be met) is a significant factor in the DFFS evaluation for all alternatives.	RE: EPA Comment Item 2.b Respondents' comments are noted.	RE: EPA Comment Item 2.b No revisions were made regarding this comment.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			RE: EPA Comment Item 2.b This statement is untrue. The DFFS provides extensive analysis of potential risk and includes consideration of not just the volume and concentration of contaminants, but also their location and risk for release or future exposure. See the detailed evaluation of each alternative (Sections 7.3.3.1, 7.4.3.1, etc.) and the comparative evaluation (Section 8.3.1) of the DFFS. The EPA's analysis treats all DNAPL as having the same residual risk. The EPA's analysis is deficient because it ignores the variability in residual risk resulting from contamination in different locations and with different mobility characteristics.	RE: EPA Comment Item 2.b In the December 3, 2014 meeting, EPA agreed to provide an additional response regarding this issue. EPA stands on its definition of oil-wetted or oil-coated soil or sediment as PTW, which is to be addressed consistently (see PRP Response No. 41). Differing locations (e.g., depth) and mobility may influence prioritizing interim actions but a final remedy must address all PTW unless technically impracticable.	RE: EPA Comment Item 2.b For the purposes of the FS, all oil-wetted or oil-coated soil or sediment is assumed to be PTW. The range of alternatives were constructed to prioritize treatment or removal of PTWs in certain areas. Potentially mobile DNAPL near the lake exhibits a greater risk to the lake than DNAPL further upland. A discussion regarding differentiating factors of DNAPL for the purpose of developing a range of remedial alternatives has been added to Section 4.4.1.8. Note that the FS does not differentiate actions that may be taken under interim and final remedies.
3	Disapproval of Section 7	**Biased Assessment of Remedial Technologies.** EPA is also disapproving Section 7 because certain aspects of the evaluation of alternatives were based on several overarching assumptions that resulted in biased evaluations. For example: a) Respondents use the assumption that generation of residuals associated with dredging or excavation are such a disadvantage that any alternative that is removal-based cannot achieve the best balance of pros and cons to justify selection of primarily removal based alternative. For example: i. Respondents discuss at great length the contention that dredging causes unacceptable levels of residuals. EPA acknowledges that residuals especially residuals associated with DNAPL are particularly troublesome. EPA has also made this comment in our comments on the draft FS. The Respondents reference source information that is considered dated at this point. Since that time, there have been advances in dredging technology. In fact, some recent cleanup	RE: EPA Comment Item 3 Section 7 of the DFFS includes discussion of impacts regarding capping (Figure 7-4), describes impacts from both dredging and capping, and acknowledges that BMPs can be used to control impacts. We strongly disagree with the EPA's contention that the DFFS precludes alternatives that include source removal. Source removal, including sediment dredging, is a significant component of the remedy that Respondents	RE: EPA Comment Item 3 Respondents' comments are noted. Respondents may revise discussions regarding the effectiveness of BMPs for mitigating construction impacts and controlling residuals, which EPA will review prior to finalizing the FS.	RE: EPA Comment Item 3 Statements regarding BMP effectiveness, including clarifications that residuals will be managed but are not expected to be eliminated, have been included in the Final FS.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
		dredge projects have achieved cleanup numbers on dredged surfaces without incorporating the use of thin sand covers over residual contaminated surfaces. ii. Respondents failed to acknowledge a number of troublesome issues about the use of capping on contaminated sediments. Aside from the fact, that alternatives that rely heavily on the use of aquatic caps, in perpetuity, can be eroded or damaged will require monitoring and maintenance "forever". A cap that fails because it erodes or is damaged can release contamination for a long time before it is noticed. Whether these releases are not as significant or maybe more significant than dredge residuals is unknowable. iii. Respondents propose the use of some recently developed technologies, amended caps and RCM caps, where there is no field data or experience regarding the long-term use and effectiveness of reactive caps. They show promise however, the many concerns about their reliability was not addressed, such as at Quendall where nearshore bathymetry must be maintained, and if a RCM cap was installed, how is it replaced or repaired without causing releases or badly damaging the habitat. b) However, as noted, residuals can be a result of dredging but Respondents cannot automatically assume that residuals will cause a failure to meet cleanup numbers with today's technology and practices. Respondents fail to pay equal attention to the problems associated with alternatives that rely on ICs, in addition to capping, for remedial protectiveness and reliability. More can be done to prevent exposure to dredge residuals than to ensure the enforcement of ICs.	proposed as having the best balance of tradeoffs (new Alternative 4a). Advances in sediment dredging technology were incorporated as described in PRP Response No. 5 to EPA Comment Item 3.a.i below. On the contrary, we believe that EPA's analysis is highly biased toward full removal/treatment alternatives without providing a technical basis for this apparent bias. Their analysis understates the potential impacts of the large-scale removals proposed in Alternatives 7 through 10 by assuming that BMPs will be adequate to mitigate all impacts, and overstates the ability to control residuals (see PRP Response No. 5 to EPA Comment Item 3.a.i below). We strongly disagree with the EPA's assumption regarding the potential for residuals, based on the subsurface complexities of the Site. The EPA's analysis of alternatives is predicated on the potential for Alternatives 7 through 10 to achieve MCLs in groundwater, but no technical justification or relevant case studies (i.e., dredging at coal tar/creosote sites) are provided.		
			<u>RE: EPA Comment Item 3.a.i</u> The DFFS alternatives include consideration of advances in technology, for example the SedVac technology for dredging DNAPL-containing sediments. This technology is more recent than the mechanical environmental bucket technology the EPA has added, and more	<u>RE: EPA Comment Item 3.a.i</u> Respondents' comments are noted and EPA agrees to strike this comment and the revision to Section 7.5.5.3.	<u>RE: EPA Comment Item 3.a.i</u> Language has been revised as indicated.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			applicable and protective for the shallow DNAPL in the TD area. We requested information from Shawn Blocker on the EPA's "recent cleanup dredge projects [that] have achieved cleanup numbers on dredged surfaces without incorporating the use of thin sand covers over residual contaminated surfaces" but no information was provided. The Boeing Plant 2 and Todd Shipyard case studies are not relevant since they did not include dredging of NAPL or, more specifically, coal tar DNAPL. Section 7.5.5.3 of the DFFS states: *Based on detailed studies performed at a range of environmental dredging sites which included silt curtains or similar technologies, approximately 2 to 4 percent of the mass of hydrophobic contaminants such as cPAHs that are dredged are released into the water column, with most of the release being in the bioavailable dissolved form (Bridges et al. 2010)*. We disagree that a 2010 reference should be considered 'dated'. Also note that EPA has deleted the above statement and replaced it with: *As discussed in Appendix C, Section C5.3.2, studies have concluded that a small percentage of the solids excavated or dredged during the last dredge production cut may accumulate as a post-dredge residual layer*. It is inconsistent to replace a water		

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			column release reference with a sediment residual reference. We disagree with this revision to the text.		
			RE: EPA Comment Item 3.a.ii Issues related to long-term monitoring and maintenance of caps were considered in the DFFS evaluation. The EPA's added statement: A cap that fails because it erodes or is damaged can release contamination for a long time before it is noticed is not relevant since there is no current DNAPL seepage observed in the existing (uncapped) condition. Note that the Respondent's preferred remedy includes dredging of all shallow DNAPL and capping of areas where DNAPL is deep and isolated by existing sediment.	RE: EPA Comment Item 3 a.ii EPA stands by the added statement. During oversight of the September 9, 2014 shoreline assessment by Grette Associates, sheens were observed in the water north of the T-dock. Bubbles of product floating to the surface were also observed as the team walked through the water. EPA will provide Respondents with photos showing the sheens.	RE: EPA Comment Item 3 a.ii EPA's added statement has been retained.
			RE: EPA Comment Item 3 a.iii Field data on the long-term effectiveness of RCM caps is accumulating. The EPA Region 10-approved remedy at the McCormick and Baxter site has both bulk organoclay and RCM caps spanning 23 acres that were installed in 2004. Extensive laboratory and field testing in 2006 and 2008 confirmed that both caps are performing as designed (Blischke and Olsta, 2009). These capping technologies have widespread usage, as discussed in Appendix C of the	RE: EPA Comment Item 3.a.iii Respondents' comments are noted. Note that during the December 3, 2014 meeting, EPA agreed that in the Final FS, amended sand caps could be included for alternatives that proposed RCM caps in the nearshore area, and that RCM caps could still be used for alternatives that proposed them for T-Dock sediment. Respondents may revise discussion of RCM caps in the context that RCM caps could	RE: EPA Comment Item 3.a.iii As discussed with EPA in the August 27, 2015 meeting, RCM caps have been incorporated into Alternatives 2 through 6 for DNAPL Areas not dredged, with the exception of DA-6 which is addressed with an amended sand cap.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			DFFS. In Section 7.5.3.2, the EPA added the statement: *Mixing reactive material with capping media is an evolving technology and is expected to be used successfully in the future*. This statement is not relevant since RCM placement without release of DNAPL has been demonstrated as described in Appendix C, and EPA Comment Item 121 indicates EPA had no comments on Appendix C. EPA's comments and text rewrites (e.g., rating implementability low for Alternative 3) expresses a bias against capping, particularly RCM caps, which is inappropriate for an FS that is intended to objectively evaluate a range of remedial options. As described above, capping has been evaluated and successfully implemented at numerous sites and should be considered a highly implementable technology.	still be used for alternatives that proposed them for T-Dock sediment. EPA will review revisions prior to finalizing the FS. Ratings modifications are addressed in PRP Response No. 48.	
			RE: EPA Comment Item 3.b The DFFS discusses limitations due to ICs. Note that the EPA's rewrite of Section 7 acknowledges that long-term monitoring and ICs in both the upland and aquatic areas will be needed in perpetuity to ensure effectiveness for Alternatives 7 through 10 (see Section 7.9.4.3). Yet the EPA's analysis is heavily biased against Alternatives 2 through 6 based on the EPA's perception of the uncertainty in enforcing and maintaining ICs,	RE: EPA Comment Item 3.b Respondents' comments are noted. EPA agrees that ICs will be necessary to some degree for all of the alternatives, but maintains that **ICs are more reliably enforceable in the uplands as compared with the aquatic environment.** The Respondents may change the language under Administrative Feasibility for Alternative 2, Section 7.3.6.2 ("However, many of the institutional controls intended to protect aquatic remedial	RE: EPA Comment Item 3.b Language has been revised as indicated.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			even though all ICs discussed have been commonly implemented at similar sites.	technologies are unenforceable") to be consistent with the **bold** statement above. Ratings modifications are addressed in PRP Response No. 48.	
4	Disapproval of Section 8	**EPA Disapproves Section 8 of the Draft FS.** EPA is disapproving Section 8 of Respondents' draft final FS, dated October 14, 2013. Section 8 of the FS is deficient. The Respondents' comparative evaluation is based on the evaluation of individual alternatives in Section 7. Unfortunately, because Section 7 is not consistent with the NCP and RI/FS guidance in the way in which many of the NCP 9 Criteria are meant to be applied, or the evaluation is incomplete, Section 8 does not contain justifiable results from the comparative analysis using the NCP's 9 Criteria.	As discussed in other comment responses, we disagree with the EPA's contention that Section 7 of the DFFS is inconsistent with the NCP and RI/FS guidance. We also disagree with the EPA's characterization of Section 8 of the DFFS as deficient. The primary substantive change in the EPA's rewrite of Section 8 is deletion of the comparative analysis for Alternatives 2 through 6 on the basis that these alternatives would not qualify for a TI Waiver (a premature consideration at the FS-stage of the remedy selection process).	As noted in PRP Response No. 1, EPA agrees that all alternatives will be included in the comparative analysis and that the TI waiver language may be removed.	Per August 27, 2015 meeting, EPA has revised this comment to be 'approved with comments'. The Final FS incorporates EPA's October 2014 version of Section 8 with revisions based on adding in Alternatives 2 through 6 to the comparative analysis and for consistency with revisions to Section 7.
5	General	**Renamed Alternatives.** EPA has renamed the Alternatives, except Alternative 2, because not all alternatives are containment alternatives. Generally, EPA just deleted the term "Containment" when used for Alternatives 3 through 10. EPA wants each alternative to reflect the difference between alternatives.			EPA's alternative names are adopted in the final FS.
6	General	**Addition of Alternative 4a.** EPA added the Respondents Preferred Alternative, 4a, into Section 6 and has carried it through the remaining sections of the FS. The text EPA used for Alternative 4a was developed by considering the text for Alternatives 3 and 4 and the Respondents' March 14, 2014 Technical Memorandum. Where information was lacking EPA considered information in Alternatives 3 and 5 as suggested by the Respondents. EPA stated several times that the Respondents should provide the same information for Alternative 4a as they provided to EPA for the other alternatives. EPA never received a complete set of information for Alternative 4a.	Relevant information for Alternative 4a was provided in Aspect's March 14, 2014 technical memorandum re: Proposed Preferred Remedy at the Site.	Comment noted.	Alternative 4a has been incorporated.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
7	General	**Habitat Area.** The Habitat Area shall not contain a PRB or collection trenches or other remedial technology without the permission of EPA, the Muckleshoot Tribes and Trustees. These technologies are incompatible with the purpose of the Habitat Area and cannot be maintained or replaced without significant damage to the Habitat Area. In addition, EPA does not want discussions about potential alternations of the shoreline in the FS —this is a remedial design issue. Additionally, so little information has been provided by the Respondents that EPA cannot comment on the concept of shoreline alternation. This is an issue for RD and would also be dependent on the alternative selected as the remedy for Quendall.	As previously directed by the EPA, the DFFS assumes that PRB/trenches are not located in habitat area. However, we disagree with the EPA's statement that all remedial technologies are incompatible with the habitat area. Compatibility should be evaluated on a case-by-case basis during remedial design. Categorically excluding remedial components in the habitat area without detailed evaluation of compatibility limits the effectiveness and potential benefits of certain remedial technologies.	Comment noted.	Based on discussions during 8/27/2015 meeting and email by Claire Hong dated 9/9/2015, Alternatives 2, 3, and 4A will show an amended sand cap with alteration of the shoreline consistent with Alternative 2 of the draft final FS.
8	General	**Renton SMP.** EPA has determined that the Renton SMP is not an ARAR.	We strongly disagree and have explained the basis of our objection to the EPA's ARAR determination in Respondent's letter to Lynda Priddy of the EPA regarding Dispute Resolution – Comment on Draft Final FS, dated November 6, 2014.	This issue has been addressed outside of the technical group.	Action-Specific ARAR table (Table 4-2) has been modified as determined in November 2014 dispute resolution, including adding Renton SMP as an ARAR.
9	General	**Risk-based PRGs at 10^{-6}.** EPA has identified risk-based PRGs at a risk level of 10^{-6} in the Draft Final FS. The exception is naphthalene in groundwater, where a RBC of 1.4 ug/L based on a risk level of 10^{-5} is used, for reasons provided in the text.	The EPA has not provided any basis for changing the risk level from 10^{-5} to 10^{-6} for identifying PRGs (for purposes of the DFFS)	EPA changed the risk level from 10^{-5} to 10^{-6} to be consistent with the NCP per 40 CFR 300.430(e)(2)(i), using 10^{-6} as a point of departure.	PRGs have been revised to reflect risk level of 10^{-6}. Note that per EPA comments, the table highlights the naphthalene PRG as 10^{-6}, but notes that the extent of naphthalene contamination from Quendall for the purposes of the FS is based on the 10^{-5} value. Note: the most recent RBCs, based on EPA's June 2015 RSLs, identify a naphthalene RBC of 1.7 ug/L rather than 1.4 ug/L.
10	General	**Impermeable Caps.** The Respondents cannot make claims that impermeable caps associated with future development can impact DNAPL mobility, etc., with the implication that it would aid remediation unless the	Evaluation of DFFS alternatives assume permeable caps. However, because impermeable caps	Respondents may include a discussion in the Final FS of how impermeable caps could affect the remedy.	A discussion of the effect of impermeable caps has been included.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
		Respondents want to install an impermeable cap during remedial action. Otherwise, the occurrence of an impermeable cap is speculation.	are a possible component of future development, it is important to state how such a cap would affect the remedy. Impermeable caps are expected to be compatible with the chosen remedy because, if anything, leaching would be reduced as stated in the DFFS. It is unclear why the EPA wants to remove this evaluation when it addresses a potential future change of Site conditions. Furthermore, EPA previously agreed to include impermeable caps in the groundwater model because of the likelihood that such a cap will be installed in the future.		
11	General	**Thermal Treatment.** The type of thermal treatment will be determined in RD. The term "thermal desorption" was often used and not well-defined. Thermal desorption can refer to a number of different thermal treatment systems, especially when the temperature range is not specified, or whether an afterburner is coupled with the treatment system. Therefore, the term "thermal desorption" is replaced by the term "thermal treatment".	Thermal desorption is well defined in Section 5.3.2.5. Thermal treatment is used in the DFFS as a more general term that includes vitrification and incineration. Replacing thermal desorption with thermal treatment adds confusion.	Respondents may add a footnote in the Final FS excluding vitrification from thermal treatment; otherwise the terminology change stands.	A footnote has been added to Section 6.1 where Alternatives 8, 9, and 10 are first described. The footnote is consistent with the revised text in EPA Comment Items 49 and 60.
12	General	**RCM Caps.** EPA has a number of concerns regarding the use of RCM caps. There is little, if any field data, on the service life of reactive materials as used in various technologies. Analytical calculations are used to "estimate" the service life or replacement rate of reactive materials. Additionally, the replacement process has not been described and the impacts associated with removing or adding additional material when needed. The obstacles to be encountered at Quendall when placing or removing RCM caps has not fully been addressed. The placement of a RCM could be compromised by the extensive amount of wood debris in or on the Quendall sediments. These issues have not been discussed sufficiently in the FS, especially in the evaluation of alternatives.	See PRP Response No. 7 to EPA Comment Item 3.a.iii. EPA Comment Item 121 indicates that EPA had no comments on Appendix C. The issues identified in this comment related to debris or replacement could be addressed in the FS and do not provide a basis for eliminating an organoclay RCM cap. A debris survey and removal of large debris would likely be part of the sediment remedy whether dredging or capping is selected. Typically, these caps are designed with a large factor of safety that	Respondents' comments are noted. Respondents may revise discussion of RCM caps in Section 7.3.3.2 in the context that RCM caps could still be used for alternatives that proposed them for T-Dock sediment. EPA will review revisions prior to finalizing the FS.	As discussed with EPA on 7/30/2015, RCM caps may also be proposed for nearshore areas. Alternatives 2, 3, and 4A include amended sand cap in QP-S DNAPL area (DA-6). All other caps above DNAPL sediments are RCMs.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			minimizes the frequency and need for replacement. More Site-specific data could be collected to support a Site-specific application. The EPA-approved West Branch of the Grand Calumet River project includes a 6-inch organo-clay cap with an estimated design life of 420 years.		
13	General	**One Process Option.** EPA does not see a reason to include more than one process option in a given alternative (e.g., amended sand cap and RCM cap), as that decision can be considered during remedial design. EPA eliminated the amended sand cap and used the RCM cap as the representative process option.	In the EPA's rewrite, the EPA states that amended caps are more reliable and have fewer concerns for implementability, maintenance, and replacement than RCMs (Section 7.3.6.1). It is unclear why the EPA chose to retain the process option they perceive as less reliable. The EPA's comments and text rewrite expresses a bias against capping that is inappropriate for an FS, which is intended to objectively evaluate a range of remedial options.	As noted earlier, during the December 3, 2014 meeting, EPA agreed that in the Final FS, amended sand caps could be included for alternatives that proposed RCM caps in the nearshore area, and that RCM caps could still be used for alternatives that proposed them for T-Dock sediment. The Respondents may revise the text describing RCM caps, which EPA will review prior to finalizing the FS.	See Response to EPA Item #12.
14	General	**ENR Area**. EPA changed the ENR area to be determined as twice the BTV rather than 8 times the BTV.	What is the basis for 2X the BTV? No basis has been provided in the comments or in the revised text.	Respondents may use 8x the BTV in the Final FS and note that the actual criterion will be developed during RD. Respondents may add an appendix with the calculation supporting the 8x value.	Revision: Appendix B1b was added which consists of a calculation supporting the 8X value.
15	Executive Summary	1. Replace text with Attachment 4. 2. Delete Tables ES-2, ES-3, and ES-4. 3. Renumber remedy component figures to accommodate Alternative 4a. 4. Renumber original Figure ES-14 (projected groundwater restoration) to ES-16 and remove Note 1. 5. Original Figure ES-15 (DNAPL volumes removed or treated) remains Figure ES-15. 6. Delete original Figure ES-16 (reduction in mass flux).			The Final FS incorporates EPA's October 2014 version of the Executive Summary with revisions based on subsequent discussions with EPA and as noted in this table. Table and Figures have been revised as requested.
16	1.1, Modifying Criteria	Add "and Tribal" acceptance to Item 8.			Revised as requested.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
17	2.0, 1st paragraph, 4th sentence, and elsewhere in the document	Change "*Conner Homes*" to "Barbee Mill".			Revised as requested.
18	2.0, 4th paragraph; last sentence	Delete "*(catch and release)*".			Revised as requested.
19	3.1, last bullet	Delete sentence "*Tank bottoms from nearby storage tanks were also reportedly placed west of the North Sump, where Quendall Pond is now located.*"			Revised as requested.
20	3.1, new last bullet	Add an additional bullet (after the North and South Sump bullet): "Quendall Pond, located near the shoreline, was constructed in an area where tank bottoms from nearby storage tanks were placed. This area also received wastes from North Sump overflows. Waste from Quendall Pond has migrated into adjacent Lake Washington."	This text revision is misleading. We are not aware of any waste (e.g. DNAPL) from Quendall Pond migrating into Lake Washington. Suggested edit to last sentence: *DNAPL from Quendall Pond has migrated into* ***sediments beneath*** *Lake Washington.*	EPA disagrees with the suggested edit. There is insufficient data to support limiting the impact of Quendall Pond waste on the sediments in the lake versus the lake in general	Revised as requested.
21	3.2, last paragraph, 2nd sentence	Revise to: "Evidence from field observations suggest that interbedded, low-permeability layers in the Shallow Alluvium can stop, slow, or alter migration of DNAPL."			Revised as requested.
22	3.2, last paragraph, last sentence	After "*many remedial technologies*", add: "such as pump and treat and *in situ* thermal and chemical treatment".			Revised as requested.
23	3.3, 5th paragraph, 1st sentence	Revise to: "There is no continuous aquitard separating the Shallow and Deep Aquifers; however, the Deep Aquifer is considered to be a semi-confined aquifer, as the vertical hydraulic interaction between the Shallow and Deep Aquifers is limited by the horizontal stratification of the Shallow Alluvium, and varies depending on the location on the Site."			Revised as requested, with the following edits: 1) "*aquitard*" has been edited to "*aquitard layer*"; and 2) "*horizontal stratification of the Shallow Alluvium"* has been edited to "*horizontal stratification and low permeability layers within the Shallow Alluvium".*
24	3.5, 5th paragraph, 3rd sentence	Delete: "conservative drinking water-based" from this sentence.			Revised as requested.
25	3.5, 5th paragraph, last sentence	Add "at this location" after "low-permeability lacustrine silt/clay unit".			Revision added. Additional correction to this sentence made:

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
					should be well BH-20C, screened from 113 to 120 feet bgs
26	3.5, 6th paragraph, last sentence	Replace last two sentences "*However, four samples…*" with: "There are a few instances of very low detections of benzo(a)pyrene above the MCL in areas outside of the DNAPL "footprint", but they are either bordering on the footprint (2 µg/L in BH-12 and 2.3 µg/L at BH-18A) or are at concentrations very close to the MCL (0.24 µg/L at BH-29A and 0.23 µg/L at WP-4)."	The new sentences should be added without the indicated deletion. Soil data are relevant to evaluating the distribution of cPAHs in groundwater in areas where the soil data provide better resolution than the available groundwater data. The soil data are important in the evaluation of the restoration time frame for benzo[a]pyrene.	EPA agrees that the new sentences can be added without the indicated deletion.	Revised as requested.
27	3.5, last paragraph, last two sentences	Change the last four sentences to: "The approximate extent of surface sediment contamination beyond the nearshore groundwater discharge area that is attributable to historical spills along the T-Dock is represented by the area exceeding the cPAH background threshold value (BTV) of 17.5 milligrams per kilogram normalized to organic carbon (mg/kg-OC).[11] The derivation of the BTV is described in Appendix B (B-1). It was used in this FS to approximate the extent of sediments that may require remediation. As depicted on Figure 3-11, approximately 29 acres of sediments at the Site exceed the BTV."			Revised as requested.
28	3.6.2.3, 1st paragraph, 2nd sentence	Change "*transition zone*" to "transition zone between groundwater and surface sediments/porewater".			Revised as requested.
29	3.6.2.3, 2nd paragraph, last sentence	Replace with: "The model was used to simulate downward flux of sulfate from overlying lake water, and the results are consistent with the reduction in BTEX and LPAH concentrations over the last several feet of transition zone between Site groundwater and the surface water of Lake Washington. Sulfate reduction processes may be occurring at the Site (even though there are no data to confirm sulfate reduction).			Revised as requested.
30	3.8, 3rd paragraph, 3rd and 4th sentences	Replace with: "The migration of dissolved indicator chemicals in groundwater is primarily controlled by the advective east-to-west groundwater flow and contaminant-specific mobility. Benzene and naphthalene are relatively mobile and, based on both empirical data and groundwater modeling, have likely migrated deeper primarily due to dispersion (to more than 110 feet bgs, impacting groundwater in the Deeper Alluvium), and further downgradient (i.e., toward Lake Washington) from DNAPL source areas compared to the less mobile cPAHs.			Revised as requested.
31	4.0	Replace with Attachment 2.			The Final FS incorporates EPA's October 2014 version of Section 4 with revisions based on subsequent discussions

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
					with EPA and as noted in this table.
32	5.0, 2nd paragraph, last sentence	Replace "*It is expected…*" with: "Remedial technologies/ process options are defined in the Record of Decision; however, during remedial design minor changes in a particular process option, such as exchanging the type of reactive material to be used in a RCM, maybe considered if its implementation results in comparable or improved long-term effectiveness and reliability, lower cost, or a comparable or improved rating of any of the other CERCLA evaluation criteria. However, replacing one technology, such as an engineered sand cap for another technology, such as an RCM, could be viewed as a significant change and warrant an additional detailed technical evaluation and potential Explanation of Significant Differences.			Revised as requested.
33	5.1.1, 1st paragraph, 1st sentence	Replace "*engineering or institutional controls*" with "engineering controls or control of exposure to hazardous substances by use of institutional controls".			Revised as requested.
34	5.1.1, first bullet	Replace with: "**Institutional Controls.** Institutional controls are non-engineered measures that may be selected as remedial or response actions typically in combination with engineered remedies For example, institutional controls may include administrative and legal controls that minimize the potential for human exposure to contamination by limiting land or resource use (EPA 2000). The NCP sets forth environmentally beneficial preferences for permanent solutions, such as complete elimination risk or treatment of principal threats waste rather than control of risks using containment for example. Where permanent and/or complete elimination are not practicable, the NCP creates the expectation that EPA will use institutional controls to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants. It states that institutional controls may not be used as a sole remedy unless active measures are determined not to be practicable, based on balancing trade-offs among alternatives (40 CFR 300.430 [a][1][iii])." Add (EPA 2000) to the references: EPA, 2000, Institutional Controls: A Site Manager's Guide to Identifying, Evaluating, and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups. OSWER 9355.0-74FS-P. EPA 540-F-00-005. September, 2000.			Revised as requested.
35	5.1.1, 5th bullet	Move "Removal" bullet to after "Ex Situ Treatment" and before "Disposal".			Revised as requested.
36	5.1.1, 6th bullet	Revise to: "*Ex situ* treatment technologies destroy or immobilize contaminants in media that have been removed from the media surface or subsurface."			Revised as requested.
37	5.2, 2nd bullet	Revise "*PAHs*" to "carcinogenic PAHs (cPAHs)".			Revised as requested.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
38	5.2, 3rd paragraph, 2nd sentence	Revise to: "Subsurface conditions, such as fine-grained soils, heterogeneous subsurface or lack of a continuous aquitard, can limit the effectiveness of many types of containment and groundwater collection technologies."			Revised as requested.
39	5.3.1.1	Fix typo: "optiozns"			Revised as requested.
40	5.3.1.1, 2nd paragraph, 1st sentence	Revise to: "These institutional controls can be effective when combined with active remediation such as capping sediments, are implementable under a wide range of conditions, and generally apply to the entire Site."			Revised as requested.
41	5.3.1.3, In Situ Thermal, 3rd paragraph, 1st sentence	Revise to: "*In situ* thermal treatment process options are expected to be more costly than other *in situ* treatment methods and more uncertain in effectiveness for treating creosote or coal tar DNAPL based on limited full-scale application."			Revised as requested.
42	5.3.1.3, In Situ Stabilization, 2nd paragraph, only sentence	Change "*potentially effective*" to "largely effective".			Revised as requested.
43	5.3.2.1, 2nd sentence	Revise to: "These institutional controls can be effective when coupled with active remediation and implementable under a wide range of conditions and generally apply to the entire Site."			Revised as requested.
44	5.3.2.2, 1st paragraph, 2nd sentence	Revise to: "The long-term cap integrity can be maintained through implementation of appropriate institutional controls and targeted long-term monitoring."			Revised as requested.
45	5.3.2.2, 2nd paragraph (after three bullets)	Delete: "Although implementation of low permeability and impervious caps are relatively more expensive then permeable caps, they may be appropriate in portions of the Site or for some future Site uses, and can be more effective than permeable caps by preventing infiltration and reducing leaching of contaminants. Permeable caps may be more cost-effective to protect against direct contact with contaminated soil in areas where leaching is not a concern."	We disagree with this deletion. See PRP Response No. 14 to EPA Comment Item 10.	Respondents may include a discussion of how impermeable caps could affect the remedy.	Original language discussing effect of impermeable caps has been retained.
46	5.3.2.3, In Situ Stabilization, 1st sentence	Revise to: "*In situ* solidification/stabilization described in Section 5.3.1.3 for DNAPL is applicable and effective for immobilizing Site COCs in soil as it is the most common remedial technology used at creosote/coal tar Superfund Sites."	What is the authority for the statement that *in situ* solidification/stabilization is the most common remedial technology used at creosote/coal tar Superfund Sites?	EPA will provide the Superfund annual report on remedy implementation.	Reference provided by EPA does not support that ISS is the most common remedial technology. Will revise text to state "…it is a remedial technology commonly used at…"
47	5.3.2.3, Bioremediation, last paragraph, 1st sentence	Delete "*Biodegradation is ongoing at the Site*".	We disagree with this deletion. In describing the potential effectiveness of bioremediation, it is important to note that biodegradation is an ongoing process at the	Respondents may keep this statement if supported, for example: "As evidenced by ____, biodegradation is ongoing at the Site."	Support for this statement has been added.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			Site. Bioremediation is less effective at sites where natural biodegradation does not occur.		
48	5.3.2.5, Ex Situ Thermal Treatment, Thermal Desorption bullet, 2nd sentence	Revise to: "This technology is effective for VOCs and certain SVOCs, achieving 90 to 99.7 percent reductions…."			Revised as requested.
49	5.3.2.5, Ex Situ Thermal Treatment, last sentence	Revise to: "Therefore, thermal desorption has been retained as a representative *ex situ* thermal treatment process option for soil. However, for the purpose of the FS, it will be referred to as "thermal treatment", as the specifications for the treated material and emission standards will be determined during remedial design."			Revised as requested.
50	5.3.2.6, Onsite Beneficial Use, 1st paragraph	Fix typo: "use consist include".			Revised as requested.
51	5.3.3.4, PRB, 4th sentence	Revise to: "As groundwater flows through the barrier, permeable materials within the barrier sorb dissolved-phase constituents and can promote attenuation."			Revised as requested.
52	5.3.3.4, Bioremediation, paragraph after bullets, 1st sentence.	Change "*Biodegradation of Site COCs…*" to "Bioremediation of Site COCs…"			Revised as requested.
53	5.3.4.1, 2nd paragraph, 4th sentence	Delete: "In addition, for alternatives with a dredging component, short-term fish consumption advisories may be required due to the potential for short-term water quality and fish tissue impacts during dredging."			Revised as requested.
54	5.3.4.2, Sediment ENR, 2nd to last sentence	Delete: "Specifically, the thin-layer placement has remained stable during 10 years of monitoring".			Revised as requested.
55	5.3.4.5, Excavation, 1st sentence	Revise to: "Process options for nearshore excavation include:"			Revised as requested.
56	5.3.4.5, Excavation, 1st bullet	Revise to: "Use of long-reaching excavators positioned from upland staging areas to remove contaminated sediment combined with the use of sheet pile containment;"			Revised as requested.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
57	Section 5.3.4.5, Dredging, 2nd bullet, 2nd sentence	Revise to: "Environmental buckets vary in size and can be retrofitted to address different degrees of sediment hardness. For example, at the Todd Shipyard Sediment Operable Unit at Harbor Island (Todd), large steel plates were soldered to the sides of an environmental bucket to provide more weight for penetrating sediments. Appropriately large environmental buckets can be used to handle debris. For example, at Todd large and cumbersome shipyard debris was successfully removed (see Figure 5-1)." Create a new Figure 5-1 with the figure provided at the end of this comment chart. Caption the figure: "Environmental Dredge Bucket Used at Todd Shipyard, Harbor Island, Washington."	See PRP Response No. 5 to EPA Comment Item 3.a.i.	EPA stands by this revision.	Revised as requested.
58	Section 5.3.4.5, Dredging, 2nd paragraph, 2nd sentence	Revise to: "However, many of these effects are reduced due to recent innovations, increased operator expertise, use of containment (e.g., sheet piles, silt curtains, booms), best management practices (BMPs) (e.g., production rates, bucket control, etc.), and/or by equipment selection. Recent dredging events at the Boeing facility on the Duwamish River were accomplished without exceedances of sediment cleanup numbers."	We disagree with this revision because it fails to consider the presence of DNAPL. Recent innovations have reduced the 4R's (resuspension, release, residual, and risk) related to solid-phase contaminants, but do not completely address potential effects due to dredging sediments with DNAPL. The EPA's proposed revision is not adequately considering the complexity of the DNAPL source distribution and subsurface heterogeneity at the Site.	EPA is refining its comments to change "many of these effects are reduced" to "many of these effects may be reduced", and to delete the sentence referencing the dredging on the Duwamish.	Revised in accordance with refined comment.
59	Section 5.3.4.6, Ex Situ Treatment, 2nd paragraph, 1st sentence	Revised to: "Thermal desorption is equally effective as vitrification and incineration in treating VOCs and some SVOCs in excavated sediment but at a much lower relative cost; . . . "			Revised as requested.
60	Section 5.3.4.6, Ex Situ Treatment, 2nd paragraph, last sentence	Revise to: "Thermal desorption of sediments may be less effective than for soils due to the higher moisture content of sediment and typically requires dewatering of sediments prior to treatment. For the purpose of the FS, the term "thermal treatment" will be used, as the specifications for the treated material and emission standards will be determined during remedial design."	See PRP Response No. 15 to EPA Comment Item 11.	Respondents may add a footnote in the Final FS excluding vitrification from thermal treatment; otherwise the terminology change stands.	See response to EPA Comment Item 11 regarding added footnote.
61	6.0	Replace with Attachment 3.			Revisions to Attachment 3 have been made in accordance with subsequent discussions with EPA and documented resolutions.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
62	7.0	Replace with Attachment 5.			Revisions to Attachment 5 have been made in accordance with subsequent discussions with EPA and documented resolutions.
63	8.0	Replace with Attachment 6.			Revisions to Attachment 6 have been made in accordance with subsequent discussions with EPA and documented resolutions.
64	9.0	Add the following references: EPA, 2002, Estimated Per Capita Fish Consumption in the United States. U.S. Environmental Protection Agency, Office of Science and Technology. EPA 821-C-02-003. August 2002. King County, 1999, Lake Sammamish Baseline Sediment Study Sampling and Analysis Plan. Prepared by the King County Department of Natural Resources, Water and Land Resources Division, Modeling, Assessment, and Analysis Unit. August 1999. King County, 2000, Lake Washington Baseline Sediment Study. Prepared by the King County Department of Natural Resources, Water and Land Resources Division, Modeling, Assessment, and Analysis Unit. June 2000.			References have been added as requested.
65	Tables 4-1 through 4-3	Replace with tables provided in Attachment 2 (Revised Section 4).			Table 4-2 has been revised in accordance with November 2014 dispute resolution.
66	Table 4-4, Soil PRGs	1. Update the RSL reference to May 2014 and update values accordingly. 2. Update table to reflect that the PRG is based is on 10^{-6} rather than 10^{-5}. This includes changes to highlights and footnotes. 3. Change the lead background value from 16 to 17 (16.8 in Table 13 from Ecology, 1994). 4. Remove highlight from the 4.2 mg/kg ecological PRG for benzo(a)pyrene. 5. Provide reference for background concentrations. 6. Remove MCL in the notes. 7. Remove MTCA RBCs (MTCA calculated values are not ARARs; RSLs are more stringent).			Revisions made as indicated, except that the RSL values and reference have been revised to "June 2015", not "May 2014", to reflect the most recent RSL update.
67	Table 4-5, Groundwater PRGs	1. Update the RSL reference to May 2014 and update values accordingly. 2. Update table to reflect that the PRG is based on 10^{-6} rather than 10^{-5}. This includes changes to highlights and footnotes. 3. On the 0.14 RSL value for naphthalene (which will be highlighted as the PRG), add the following as a footnote: "For the purpose of estimating the			Revisions made as indicated, except that the RSL values and reference have been revised to "June 2015", not "May 2014", to reflect the most recent RSL update.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
		extent of the naphthalene plume resulting from contamination at Quendall, the RSL of 1.4 ug/L is used (see Section 4.3)." 4. Remove MTCA RBCs (MTCA calculated values are not ARARs; RSLs are more stringent).			Accordingly, based on the same June 2015 guidance, the 10^{-6} RSL value for naphthalene was changed to 0.17.
68	Table 4-6, Surface Water PRGs	1. The 22 ug/L PRG for benzene needs to be revised to 2.2 ug/L (reflecting risk of 10-6). 2. Even though benzene was the only COC identified in the Baseline Risk Assessment, National Water Quality Criteria for human health (water & organism) need to be added for the other COCs and treated as ARARs (supersede RBCs): http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm			Revisions made as indicated, except that based on the most current NWQC criteria, the PRG for benzene was revised to 2.1 ug/L.
69	Table 4-7, Sediment PRGs	1. Update table to reflect that the PRG is based on 10^{-6} rather than 10^{-5}. This includes changes to highlights and footnotes. 2. Remove the numbers from the notes that are not referenced with a number in the body of the table. 3. Remove fluorene. 4. Note #5 does not make sense. Update to: Fish/shellfish ingestion PRG back calculated from RI Report Table J-7-74, using sediment EPC of 602 mg/kg OC (RI Report Table 7.1-4). 5. Update Fish/Shellfish Ingestion – Site Sediment values as follows: Using a cancer risk of 3.1 x 10^{-3} for benzo(a)pyrene (RI Table J-7-74) associated with a fish EPC of 0.216 mg/kg (wet) derived from a sediment concentration 602 mg/kg OC (RI Table 7.1-4), the RBCs for fish consumption are 19, 1.9, and 0.19 mg/kg OC for 10^{-4}, 10^{-5}, and 10^{-6}. [(602 mg/kg/0.0031 risk)*0.0001 risk = 19 mg/kg OC at 10^{-4} risk] 6. Add a column for ARARs and include the new SMS values for the appropriate COCs. 7. In the "Notes" column on the right side, note that the background threshold value (BTV) of 17.5 mg/kg OC is a 95/95 UTL considered to be a "do not exceed" value for looking at individual concentrations and comparing them to site background. The BTV is an action level as opposed to a PRG. 8. The ecological PRGs are not OC-normalized and should be clearly noted as such.			Ok. Responding to comment *8" – For clarity, a note was added indicating that concentrations of all PRGs are not OC-normalized, unless indicated otherwise.
70	Table 4-8, PRG Summary	Update to reflect changes in previous tables.			Note the RSL reference was change to "June 2015", not "May 2014", to reflect the most recent update.
71	Table 4-9	Insert new Table 4-9 provided in Attachment 2 (Revised Section 4).			New table has been added.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
72	Table 5-8, Sediment Process Options Eval.	In situ treatment, bioremediation: Change first sentence to: "Technology widely demonstrated in upland applications, but not in sediment."			Revision made as requested.
73	Table 6-1, Alts to RAOs	Delete this table. It does not provide information on to what degree and RAO is addressed.			Table has been deleted.
74	Table 6-2, Assembly of Tech/Proc Options into Alts.	Renumber to Table 6-1 and include information for Alternative 4a. Remove "Containment with" from the names of Alternatives 3 through 10.			Revised as requested.
75	Table 6-3, Alternative Summary	Delete this table. It contains inconsistent information.			Table has been deleted.
76	Table 6-4, Construction Quantities	Renumber to Table 6-2 and include information for Alternative 4a. Remove "Containment with" from the names of Alternatives 3 through 10.			Revised as requested.
77	Table 7-1, NCP Criteria	Change "State (Support Agency) Acceptance" to State (Support Agency) and Tribal Acceptance".			Revised as requested.
78	Table 7-2, DNAPL Treated/Removed	Include information for Alternative 4a. Remove "Containment with" from the names of Alternatives 3 through 10.			Revised as requested.
79	Table 7-3, IC and LTM Summary	Delete this table.			Table has been deleted.
80	New Table 7-3, Summary Evaluation of Alternatives	Use Table 8-2 as a basis and update as follows: 1. Remove "Containment with" from the names of Alternatives 3 through 10. 2. Overall Protection of Human Health and the Environment: For Alternatives 1 through 6, "No". For Alternatives 7 through 10: "Yes". 3. Complies with ARARs: For Alternatives 1 through 6, "No" with a footnote stating "A TI Waiver would not be granted because PTW is readily accessible and removal or treatment is feasible with currently available engineering technology." For Alternatives 7 through 10, "Yes" with a footnote stating "It is assumed that a TI waiver would be granted if monitoring data indicate that MCLs may not be met, since all known PTWs would be addressed under this alternative." 4. For balancing criteria, update with ratings from the text of Section 7.	For 2&3 - See PRP Response No. 1 to EPA Comment Item 2.a above and PRP Response No. 34 to Page ES-12, *Overall Protection of Human Health and the Environment* Summary below. For 4 - There are inconsistencies in the text of Section 7 on ratings. Alternative 4 is rated low for long-term effectiveness in Section 7.5.3.3 and moderate in Section 7.5.1.3. Alternative 7 is rated low for short-term effectiveness in Section	For 2 & 3, see EPA's response to PRP Response No. 1. For 4, the Respondents should correct ratings to reflect what they are in specific criteria sections, not where they are referenced (in error) in other sections. Ratings modifications are addressed in PRP Response No. 48.	Revised as requested. Also included information for Alternative 4a.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			7.5.1.3 and moderate in Section 7.5.5.5.		
81	Table 8-1, Comparative Rating of Alternatives	Delete this table.			Table has been deleted.
82	New Table 8-1	Duplicate new Table 7-3 and revise as follows: 1. For Alternatives 1 through 6, replace symbols for the balancing criteria with dashes. 2. Add footnote to the Overall Protectiveness of Human Health and the Environment criterion for Alternatives 1 through 6 stating "Because this alternative does not satisfy the Threshold Criteria, it is not carried forward in the Balancing Criteria comparison."	See PRP Response No. 34 to reference *Page ES-12, Overall Protection of Human Health and the Environment Summary* below.	EPA agrees to strike this comment.	Table 8-1 has been revised to note that Alternative 1 has not been carried forward in the balancing criteria comparison.
83	Figure 3-2	Add Quendall Pond to this figure. Even though officially constructed in 1972, it is the location where tank bottoms were reportedly placed and where contaminated fluids discharged to the North Sump may have migrated via surface or subsurface flow.			Revised as requested.
84	Figure 3-12	Add Quendall Pond to the graphic.			Revised as requested.
85	New Figure 5-1	Create a new Figure 5-1 with the figure provided at the end of this comment chart. Caption the figure: "Environmental Dredge Bucket Used at Todd Shipyard, Harbor Island, Washington."			New figure has been added.
86	Figure 6-1	Remove altered shoreline depiction.			Altered shoreline retained per discussions with EPA (see response to comment #13)
87	Section 6 figures, general	Add figures for Alternative 4a and renumber figures accordingly.			Revised as requested.
88	Section 7 figures, general	Include information for Alternative 4a.			Revised as requested.
89	Appendix A, Section A3, Item 2	Typo: Superscript 2 at the end of the last sentence.			Revised as requested.
90	A3.1.2.1, 1st bullet	Provide a range, median, and standard deviation to put the 0.77 mg/L in perspective.			Revised as requested.
91	A3.1.3, 1st paragraph	Clarify that heterogeneity in the Deep Aquifer is limited to the relatively thin upper transition zone.			Per 8/27/2015 meeting, transition zone reference removed but description of Deep Aquifer heterogeneity has been added to A3.1.3 as well as a reference to A5.1.1

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
					for more detailed discussion of heterogeneity.
92	A3.4, 4th paragraph	Provide a brief basis for the statement of no hotspot pumping benefit. The concept of "printing resolution" needs to be explained.			Revised as requested.
93	A5.3.4, 4th paragraph	2,500 gpm is acknowledged to be a significant overestimation in the text, but is used to make this option unfavorable – a common theme with the dewatering calculations. This discussion must be augmented to increase facts and minimize broad brush assumptions and conclusions. Without more foundational basis it is hard to evaluate the potential benefits.			Additional information added to the text. Estimated 1,300 gpm capture from offshore provides conservative lower bound.
94	Table A-1	Footnote 2. Provide additional detail on how f_{oc} values from the references were selected for the model. For example, the use of minimum values allows the COC to be more mobile and thus the size of the baseline plume may be larger than reality.			Footnote has been added.
95	Table A-2	In addition to average, add minimum, maximum, median, and standard deviation.			Table has been updated accordingly
96	Table A-3	Provide rationale for using an arithmetic average over some other statistic to represent these concentrations over an area.			A note has been added to table A-3.
97	Table A-7	1. Include a note about why the volume of the arsenic plume increases as opposed to no action. 2. Include a note about why the volumes of benzene and naphthalene are higher for Alternative 9 than for Alternative 7. 3. For Alternative 8, benzo(a)pyrene plume volume percent of 67% seems incorrect. Please confirm.			1. A note has been added. Clarification: assumed comment meant to say why volume of the arsenic plume increases as opposed to <u>pre-remediation.</u> _2 Volumes are higher due to recontamination of clean backfill. A note has been added. _3__Results have been confirmed using direct model output. The result is due to recontamination of excavation backfill.
98	Table A-8	Darcy Flux is confusing – instead of cm/s, show cubic cm/s per square centimeter. Check text for consistency, to be clear that it is not a velocity calculation (DF/porosity).			Revised as requested.
99	Figures A-13 through A-21	Add a large note that all applicable contours (for plan view Figures A-13 through A-17 and cross-sections for Figures A-18 through A-21) contain large solidified areas that do NOT contribute to the final plume volumes. Reference Tables A-6 and A-7, where remediated plume volumes are presented, excluding the volume of solidified materials.			A note has been added.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
100	Appendix B-1, cPAH BTV Derivation	Replace this appendix with the material provided at the end of the comment chart regarding derivation of the cPAH BTV value.			The material provided at the end of the comment table was used as a replacement for the previous Appendix B-1
101	Appendix B-2, Sand Cap Modeling, Section B2-1, 2nd & 3rd paragraphs	The RI versus current FS evaluations are unclear. Using discrete depth porewater concentrations of selected cations and naphthalene and benzene in native sediment, the RI evaluation demonstrated that the significant concentration reductions of naphthalene and benzene in groundwater/porewater entering the lake were not strongly influenced by surface water dilution, but likely other processes such as biotic and abiotic degradation. NO chemical isolation modeling results were reported in the RI. The current effort uses modeling to determine the concentration/mass loading from the natural groundwater/porewater system to the bottom of a cap. (i.e., taking the RI work to the next step). Then the performance of a cap (i.e., what steady state concentrations at the surface water cap interface) is evaluated. The use of the term "current conditions model" is unclear unless the overall modeling process framework is properly given a foundation.			Text has been added to the introduction section to clarify the step-wise approach to the modeling presented in Appendix B. Specifically that site-specific physical, chemical, and biological parameters for existing conditions were calibrated using site data. Then these parameters were used as model inputs to simulate the effect of a chemical isolation cap.
102	Appendix B-2, B2-1, 3rd paragraph	End of second sentence. Add that the meaning of the constant dissolved source contaminant concentrations is that the input from the natural system to the bottom of the engineered cap is assumed constant. Because the likely process that is reducing naphthalene and benzene concentrations is biologic, then what evidence is there that if the native sediment biota is covered by an engineered cap that the same degradation and thus source term to the bottom of the cap will take place?			Text was added to the last paragraph stating current COC loading to sediment is representative of loading to the bottom of the isolation cap layer. No site specific evidence exists that the extent of degradation of benzene and naphthalene within capped sediments will be identical to current uncapped degradation, however both benzene and naphthalene are relatively biodegradable, including under the future capped physical chemical conditions and so the extent of degradation will be comparable.
103	Appendix B-2, B2-2.1, 2nd paragraph, 2nd sentence	The constant source includes through the sediments to the bottom of the cap. Again there is confusion of the two uses of the UT model in the FS. The statement that detailed simulation of transport within the underlying soils and groundwater is not necessary is not clear unless you mean that the source term entering the natural porewater/sediment zone is constant for the use of the model to predict natural loading to the bottom of the cap (using cation and			Text was added to the introduction section of the appendix to clarify the two uses of the model. Text has also been revised within the first sentences of Section B2-

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
		actual contaminant concentrations) and that after establishing natural concentration/flux that those concentrations/flux will be constant and will be used as input to the engineered cap and that the cap performance will then be evaluated with the UT model. Need to make clear the descriptions of the two uses of the UT model in this FS. Discuss at a high level then point to Section B2-2.2 (Approach) for more details.			2.2 to clarify the two uses of the model. The purpose of Section B2-2 is to describe the model and how the model works
104	Appendix B-2, B2-2.2	Add a summary statement to this section noting that the initial model helps establish the long-term contaminant concentrations/fluxes to the bottom of the cap based on Site data and the second model evaluates the engineered cap performance.			The text has been updated as requested.
105	Appendix B-2, B2-3.1 2nd paragraph 2nd sentence	Change "*Since many of the parameters…*" to "Since many of the model input parameters…"			The text has been updated as requested.
106	Appendix B-2, B2-3.1 3rd paragraph 1st sentence	Change "*Once the model input parameters…*" to "Once the model input parameters…"			The text has been updated as requested.
107	Appendix B-2, B2-3.1 3rd and 4th paragraphs	First uses of the term "cation model". Use consistent terminology throughout this appendix. Suggest using "Cation Model" instead of Initial Model as it is more descriptive; suggest using "Cap Model" or "Cap Evaluation Model" for the modeling used to evaluate the cap performance.			The text was revised to be consistent in reference to the initial model.
108	Appendix B-2, B2-3.1 4th paragraph, last sentence	Change "*by increasing degradation rates for these COCs*" to "by increasing biotic and abiotic degradation rates for these COCs".			The text was revised to "by increasing chemical and biological degradation rates" to be consistent with other sections of the text.
109	Appendix B-2, B2-3.2.1.1	Usable data are available from greater than 40 cm. The choice of 40 cm needs additional discussion and foundation.			As stated in Section B2-3.2.1.1, 40 centimeters represents the average depth of the greatest COC concentrations observed in samples collected during the RI.
110	Appendix B-2, B2-3.2.1.3	Groundwater seepage velocities – clarify real average linear groundwater velocity or Darcy flux?			Darcy flux is the average linear groundwater velocity. The text has been revised to Darcy velocity for consistency.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
111	Appendix B-2, B2-3.3	The statements in the text do not coordinate well with the referenced figures. There is no real comparison of modeled versus actual data to evaluate the statement that the figures show good agreement.			The figure was revised to clarify how the actual data is illustrated. Text was added providing additional support of the agreement between modeled results and actual results.
112	Appendix B-2, B2-4.3	The question of what will be the input to the bottom of the cap after the cap is installed must be addressed. What effect does adding the cap have on the biotic and abiotic degradation processes?			No edit was made to the text. The cap modeling approach described in Section B2-4.2 states that concentrations of benzene and naphthalene loading to the bottom of the conceptual cap equaled average concentrations of these COCs measured in the top 10 centimeters of the existing sediment. The presence of a sand cap is not expected to have a significant long term impact on chemical or biological degradation rates for benzene and naphthalene below the cap.
113	Appendix B-2, Table B2-1	Add full rationale and discussion for lumping all cations into average cation concentrations.			A note has been added to the table stating the cations have been averaged to provide a more representative concentrations of the cations for a mixed model.
114	Appendix B-2, Table B2-2	Add a discussion of why the 40 cm benzene and naphthalene porewater concentrations are higher at 40 cm than at deeper.			The concentrations of COCs were obtained from the RI data. No evaluation was performed related to the reason this depth has the highest concentrations.
115	Appendix B-2, Figure B2-1	Change “Biodegradation” to “Biodegradation + Abiotic degradation”.			The figure has been revised as requested.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
116	Appendix B-2, Figures B2-2 and B2-3	Several comments: 1. Cap-water interface is really the natural sediment water interface, correct? 2. To what does the label "Underlying Sediment" refer? 3. What is the red bar? 4. What is below 40 cm? These are important figures and need to be complete and standalone. Notes on figures can help add clarity and coordinate better with text.			1. Yes it is the existing sediment-water interface. 2. Underlying Sediment refers to the existing sediment. Label revised. 3. The red bar represents the average normalized cation concentration and naphthalene concentration for the top 10 cm in Figures B2-2 and B2-3, respectively. 4. As stated in the text, the model was applied to the top 40 centimeters of the existing sediment. This is reflected in the figure. Concentrations below 40 cm are assumed to be equal to the initial concentration.
117	Appendix B-2, Figure B2-5	Draw the sediment/cap interface boundary on the figure. Is the cap 0-45 cm?			The figure has been revised as requested.
118	Appendix B-3, General	The analysis is Appendix B-3 is at most a screening-level analysis conducted for the purpose of estimating cost in the FS and a much more robust analysis will be required in remedial design before the need for armoring is accepted by EPA.			Comment Noted.
119	Appendix B-4, General	Not reviewed.			Comment noted.
120	Appendix B-5, General	New appendix from Draft FS; not reviewed.			Comment noted.
121	Appendix C, Technologies and Process Options	No comments.			
122	Appendix D, Ex Situ Thermal	Additional cost elements for ex-situ thermal technology could include treatment pad installation, sampling and analysis for process control, mobile equipment rental/leasing, utilities, as well as off-gas treatment. Additional details should be provided to support unit costs related to ex-situ thermal, including any potential materials credits following construction completion. (Comment from Draft FS, not addressed.)			Per 8/27/2015 meeting, clarification added that unit costs are all-inclusive, including installation, sampling, utilities, and off-gas treatment; breakout of cost elements not required.

EPA ITEM	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
123	Appendix D, Dredging BMPs	Costs for dredging BMPs could lead to a significant increase in per-cubic-yard cost for dredging. Respondents should describe how these are represented in the 25% contingency. (Comment from Draft FS, not addressed.)	Need to clarify to which BMPs the EPA is referring. The sediment environmental controls and sheet pile enclosure costs are explicitly included in the cost estimate and are not built into the dredging unit cost or covered entirely in the contingency.	EPA agrees to strike this comment.	No revisions necessary.
124	Appendix D, In situ Stabilization, Treatability Studies	The Draft FS does not provide specific cost assumptions for required treatability studies, nor information on what was included in contingency costs, and should specify such detail. (Comment from Draft FS, not addressed.)			This information is included in footnotes to the cost tables in Appendix D. Per 8/27/2015 meeting, no further detail required.
125	Appendix D, General Mob/Demob	Please note if the Mob/Demob also includes bonds and insurance? Note indicates mobilization, demob, & temp facilities. (Comment from Draft FS, not addressed.)			This information is included in footnotes to the cost tables in Appendix D. Per 8/27/2015 meeting, no further detail required.
126	Appendix E, Eng. Calculation Sheets	Not reviewed critically for Draft FS (only for reference); also not reviewed critically for Draft Final FS.			
127	Appendix F, Shoring Design Considerations	New, not reviewed.			
128	New Appendix G	EPA requires the "Baseline Wetland and Habitat Report" to be included in an appendix to the Final FS.			The Baseline Wetland and Habitat Report has been added as Appendix G.

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
30	Page ES-2, *Site Description and Source Area*	*Waste from Quendall Pond has migrated into adjacent Lake Washington.*	See PRP Response No. 19 to EPA Comment Item 20.	EPA disagrees with the suggested edit (same as Comment 19).	EPA text has been retained.
31	Page ES-7, *Site Areas and Media Targeted for Remedial Action* Also Section 4.4.1.8	*DNAPL at the Site cannot be reliably contained because any vertical barrier/treatment wall that would be installed at the Site could only be a "hanging" wall. There is no aquitard in which to anchor a barrier/treatment wall.*	The EPA's characterization that there is "no aquitard" is misleading when used in this context. The shallow alluvium contains laterally extensive low permeability peat deposits that in the aggregate limit the downward migration of DNAPL at the Site. A complete physical barrier (sides and bottom) is not needed to reliably contain all Site DNAPL. DNAPL present as oil-coated soil is not mobile. There is a finite source, and even if DNAPL present as oil-wetted soil were disturbed by future earthquakes, etc., most could not move beyond the Site boundaries. DNAPL containment strategies implemented at other CERCLA sites include hanging walls (e.g., McCormick and Baxter, PSR).	In the December 3, 2014 meeting, EPA agreed to provide an additional response regarding this issue. EPA is refining its comment to include the constituents leached from DNAPL. Revised wording: *"DNAPL <u>and groundwater-leachable constituents</u> cannot be reliably contained because . . . "* The stratigraphy/geology of the shallow alluvium, in aggregate, limits downward and lateral migration of mobile DNAPL. However, leached constituents such as benzene and naphthalene from the DNAPL source have been observed at great depths in the coarse alluvium. Therefore, the lack of a substantial, continuous, horizontal aquitard separating the shallow alluvium from the coarse alluvium renders a downgradient hanging barrier/treatment wall less effective. In addition, McCormick & Baxter is not a relevant reference because it is mostly a fully-encapsulating wall keyed to a relatively thick silt formation, except for an area near one corner. It also includes a RCRA cap that prevents infiltration.	Per 8/27/2015 meeting, to be modified to state 'EPA believes that DNAPL at the Site cannot be addressed through containment alone…'

[1] PRP Response numbers reference the response table and letter dated and submitted to EPA on November 14, 2014.

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
32	Page ES-12, *RAOs for Protection of Human Health*	*Alternatives 7 through 10 treat or remove all known PTWs and, therefore, may restore groundwater to meet drinking water standards for one or more COCs throughout most of the plume, if not all of the plume. For these alternatives, institutional controls that specifically address use of drinking water would not be fully required in perpetuity.*	We disagree with this point and the EPA does not provide a technical basis for these statements. Leaching from the solidified mass would likely require ICs for drinking water in perpetuity.	See EPA's response to PRP Response No. 1. Cited language can be changed to indicate that alternatives that treat or remove all known PTWs have significantly greater effect on plume reduction than those that leave known quantities of PTW behind. For these alternatives, institutional controls that specifically address use of drinking water may not be required across the entire site in perpetuity.	Per 8/27/2015 meeting, revised language provided in July 2015 has been added but with 'significantly' deleted.
33	Page ES-12, *RAOs for Protection of Human Health*	*…whereas a soil cap may not be needed for Alternatives 7 through 10, where all PTWs are removed or treated.*	Alternatives 7 through 10 leave contaminated soil (not DNAPL) in place that exceeds PRGs, and a soil cap would still be needed.	Respondents may qualify that less soil cover may be required for these alternatives.	Potential for thinner upland caps under Alternatives 7 through 10 is discussed.
34	Page ES-12, *Overall Protection of Human Health and the Environment Summary* Also Sections 7.3.1.3, 7.4.1.3, 7.5.1.3, 7.6.1.3, 7.7.1.3, and 7.8.1.3.	*Alternatives 2 through 6 would not meet [the threshold criterion Overall Protection of Human Health and the Environment.]*	It is unclear whether the EPA is claiming that Alternatives 2 through 6 would not meet this criterion due solely to the ARAR compliance issue, or whether the long-term effectiveness and permanence of these alternatives is also judged to be inadequate. The NCP states (*40CFR 300.430(e)(9)(iii)(A))*: *Overall protection of human health and the environment. Alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous*	See EPA's response to PRP Response No. 1.	See Response to EPA Comment #2.

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals consistent with § 300.430(e)(2)(I). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The analysis must <u>draw on</u> the assessment of other criteria. The fundamental question is whether exposures are controlled in the short-and long-term. Since ICs can be used to control exposure to groundwater exceeding MCLs, protection is achieved. In addition, the EPA determines that leaving untreated DNAPL on site results in an unacceptable risk, but does not provide its rationale. Region 10's interpretation essentially precludes consideration of containment of DNAPL as a component of any remedial action at the Site. This is inconsistent with the EPA's policy on PTW and how it has been applied at other Superfund sites involving DNAPL.		

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
35	Page ES-13, *Overall Protection of Human Health and the Environment Summary*	*Alternatives 7 through 10 would meet [the threshold criterion Overall Protection of Human Health and the Environment] because all known PTWs are removed or treated. They would also likely comply with the MCL ARAR…*	The linkage between PTW removal/treatment and meeting overall protectiveness is not clear. The statement that Alternatives 7 through 10 would likely comply with the MCL ARAR is not supported. Also, in a footnote the EPA states that some DNAPL *could be inadvertently missed during remedial implementation.* Is the EPA confident that this residual DNAPL is unlikely to significantly impact groundwater quality?	See EPA's response to PRP Response No. 1. Language such as "would likely comply with the MCL ARAR" can be changed to indicate that alternatives that treat or remove all known PTWs are presumed to have significantly greater effect on plume reduction than those that leave known quantities of PTW behind (e.g., Alternative 6 leaves 40,000 gallons). Regarding "Is EPA confident that this residual DNAPL (inadvertently missed) is unlikely to significantly impact groundwater quality?" – EPA's focus is on doing as much work as is practicable to address known PTW and reduce the source of groundwater contamination, expecting not all the PTW may be found (common in any cleanup scenario). Groundwater impacts from residual DNAPL are expected to be significantly less than those leaving 40,000 gallons or more of known PTW behind (Alternatives 1 through 6).	See Response to EPA Comment #2.
36	Page ES-13, *Compliance with the MCL ARAR*	*Benzene was predicted to exceed its MCL after 100 years for Alternatives 1 through 7 and 9. It was predicted to achieve its MCL after 28 years for Alternative 8, and after 14 years for Alternative 10. EPA believes that the timeframes for Alternatives 8 and 10 may also be relevant for Alternatives 7 and 9, given that the extent of benzene MCL exceedances based on empirical data are smaller than the model predicts, in situ solidification is likely to oxygenate the subsurface and aid in volatile attenuation, and the resulting solidified materials are not considered to be aquifer materials.*	The third point (solidified materials are not aquifer materials) is already accounted for in the groundwater model. The assumption that oxygen added during solidification will greatly reduce restoration time frame is not supported by any data; rather, similar remediation techniques (oxygen-release compounds) are not effective given the mass of	In the December 3, 2014 meeting, EPA noted that the Respondents may remove sentences saying that restoration timeframes for Alternatives 8 and 10 may be relevant for Alternatives 7 and 9. The Respondents may also remove the statement inferring that ISS may oxygenate and aid in volatile attenuation.	Indicated statements have been removed.

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			contaminants found in DNAPL. Finally, the groundwater model over-prediction of the benzene plume extent has nothing to do with estimated restoration time frame under solidification scenarios. The solidified mass acts as an on-going source in perpetuity. It is unclear how the EPA can, on this basis, conclude that these very different alternatives may have similar restoration time frames.		
37	Page ES-13, *Compliance with the MCL ARAR*	*The reason the groundwater model predicts MCL exceedances after 100 years for Alternatives 7, 8, and 9 is that it assumes a baseline condition in where benzo(a)pyrene exceeds the MCL outside of the DNAPL areas; therefore, even when the DNAPL source is removed, the model assumes that the MCL exceedances remain and do not degrade over time.*	This is incorrect – the groundwater model <u>does</u> assume that residual BaP degrades over time; it just takes >100 years to achieve the MCL.	In the December 3, 2014 meeting, EPA noted that the Respondents may change "do not degrade over time" to "do not significantly degrade over time".	This statement has been removed to be consistent with revisions to the parallel discussion in Section 7.1.1.2 (see PRP Response No. 44a)
38	Page ES-14, *Compliance with the MCL ARAR*	*For Alternatives 7 through 10, EPA believes that if the known DNAPL source is removed or treated, arsenic will also be more significantly reduced than the modeling predicts.*	We disagree with this point and the EPA does not provide any authority for this statement.	Respondents may change "arsenic will also be more significantly reduced" to "arsenic may also be more significantly reduced".	This statement has been removed to be consistent with revisions to the parallel discussion in Section 7.1.1.2 (see PRP Response No. 44a)
39	*Section 4.4* • *DNAPL Cumulative Thickness.*	*Greater cumulative thicknesses of DNAPL (either oil-coated or oil-wetted) can contribute more significantly to groundwater contamination. Further, DNAPL residuals present as thin stringers have more surface area per volume of DNAPL; therefore, cumulative thicknesses that comprise multiple layers may impact groundwater as much or more significantly than contiguous DNAPL occurrences.*	We disagree with this point and the EPA does not provide any authority for this statement. Contribution to groundwater depends also on geology, groundwater occurrence, and DNAPL leaching characteristics/weathering. The Site area with the greatest cumulative thicknesses (North Sump) has relatively modest contaminant concentrations in groundwater.	EPA agrees that multiple factors affect contribution to groundwater, but this section is focused on DNAPL cumulative thickness and the text is intended to provide support for why it is used as differentiator for the array of alternatives. Regardless of the effect on groundwater, PTW is defined as visibly oil-coated or oil-wetted soil or sediment, Cohen and Mercer (1993, cited in the RI Report) provides support for the concept of NAPL fingers and ganglia having more contact area with groundwater than an	Revision made in accordance with July 2015 response.

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
				equivalent pool of NAPL. They note that these ganglia may produce higher chemical concentrations in groundwater, while depleting the NAPL source more quickly than a NAPL pool of equivalent mass. Conversely, DNAPL pools (greater thicknesses of oil-wetted materials) may provide a source of groundwater contamination long after residual fingers and ganglia have been depleted. The Respondents may revise the first sentence to: "may contribute". The second sentence may be revised to reflect the discussion above. The Respondents may also add a sentence noting that contribution to groundwater also depends on geology, groundwater occurrence, and DNAPL leaching characteristics/weathering.	
40	*Section 4.4.1.1 Railroad DNAPL Area (RR DNAPL Area)*	*Boring BH-30C is also the only location at the Site where DNAPL has been observed in the transition zone between the Shallow Alluvium and Deep Alluvium.*	What is the "transition zone"? The RI does not refer to a transition zone and there does not appear to be any basis for labeling the area between the Shallow and Deep Alluvium as a transition zone.	EPA agrees to strike this revision.	Text has been restored to match DFFS.
41	*Section 4.4.1.8 Key Factors Influencing DNAPL Remediation*	*EPA has determined that DNAPL at the Quendall Site, whether in soils or sediments, is to be considered as PTW because of the high level of toxicity inherent in the creosote/coal tar DNAPL. Creosote/coal tar contaminants present in DNAPL (benzene and naphthalene) are also highly leachable and mobile via groundwater, and DNAPL classified as oil-wetted may also be mobile.* *DNAPL at the Site cannot be reliably contained because any vertical barrier/treatment wall that would be installed at the Site could only be a 'hanging" wall. There is no aquitard in which to anchor a barrier/treatment wall.*	Some Site DNAPL has lower mobility, lower leachability, and/or lower toxicity and should not be classified as principal threat waste. Lower mobility DNAPL at other CERCLA sites (e.g., Utah Power and Light) has been characterized as low-level threat waste. We believe this same designation is appropriate for portions of the	EPA stands on its definition of visibly oil-wetted or oil-coated soil or sediment as PTW, which is to be addressed consistently. Differing locations (e.g., depth) and mobility may influence prioritizing interim actions but a final remedy must address all PTW unless technically impracticable.	Per 8/27/2015 meeting, this sentence has been modified to state 'DNAPL at the Site cannot be addressed through containment alone…'

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
		DNAPL is accessible. The majority of DNAPL in the uplands is found within the top 20 feet of the Shallow Aquifer with two exceptions (RR Area and Former May Creek Channel).	DNAPL source at the Site. The EPA has provided no basis for designating all of the DNAPL as PTW. See PRP Response No. 31 to Page ES-7, Site Areas and Media Targeted for Remedial Action above. Sediment DNAPL is located in layers as deep as 16 feet below mudline, which provides severe technical challenges for removal.	As noted earlier, EPA is refining its comment to include the constituents leached from DNAPL. Suggested wording: "DNAPL <u>and groundwater-leachable constituents</u> cannot be reliably contained because . . . " Regarding accessibility, the text may be revised to indicate that the majority of site DNAPL is accessible, with exceptions being in the RR Area and Former May Creek Channel in the uplands and in some nearshore areas.	
42	*Section 6.3.4.5 (for example)*	*An engineered sand cap would be placed over sediments where porewater data exceeds cleanup numbers…*	What are 'cleanup numbers'?	Cleanup numbers are equivalent to PRGs. The Respondents may revise this text accordingly. In the December 3, 2014 meeting, EPA and Respondents also agreed to confirm understanding of the purpose of the sand cap. In a December 5, 2014 email from Respondents' Consultant to EPA, the following was provided: "To clarify, the proposed Engineered Sand Cap composed of 1.5 feet of sand in the nearshore Non-DNAPL areas would sufficiently reduce contaminant flux such that surface sediment porewater/surface water PRGs would be attained." Please ensure that this is clear in the final FS.	References to cleanup numbers have been replaced with PRGs.
43	*Section 7.1.1.1 Overall Protection of Human Health*	*In the detailed evaluation of each alternative, the Overall Protectiveness criterion will be rated as "No", or "Yes", based on consideration of whether: 1) all exposure pathways are mitigated; 2) the alternative has long-term effectiveness and permanence; 3) does not pose a high short-term risk; and*	See PR Response No .34, to Page ES-12, *Overall Protection of Human Health*	See EPA's response to PRP Response No. 1.	See Response to EPA Comment #2.

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
	and the Environment	*4) meets ARARs or is waived from the requirement for compliance with an ARAR.*	*and the Environment* Summary above.		
44a	*Section 7.1.1.2 Compliance with ARARs*	• *Because the baseline-generated plumes are larger than empirically determined plumes, the predicted model outcomes (restoration time frames and resultant plume sizes) are also likely to be "larger" than actual outcomes. This infers the following:* • *Model-estimated restoration time frames are longer than the actual time frames would be.* • *Model-estimated plume volumes (based on incremental removal of source) are larger than the actual plume volumes would be.* • *This is especially important for Alternatives where all source materials are treated or removed (Alternatives 7 through 10).* ◆ *For benzene and naphthalene, the remaining contaminant mass will flushed and the mass and thus groundwater concentrations of these COCs would decay over time based on their half-lives.* ◆ *For benzo(a)pyrene, empirical data indicate a close association of MCL exceedances with the occurrence of DNAPL. The model baseline condition plume for benzo(a)pyrene includes areas outside of the DNAPL footprint with MCL exceedances, while empirical data show no exceedances.[2] Therefore, the model results show that, if the DNAPL source is removed, then there are still areas of the Site with MCL exceedances that would not significantly degrade overtime. Based on empirical data, if the DNAPL source is removed, then the benzo(a)pyrene plume should also be fully addressed.* ◆ *For arsenic, treatment or removal of the DNAPL source is anticipated to affect a change in the subsurface reducing conditions that have enhanced arsenic mobility.* [1] *Note that there are a few instances of very low detections of benzo[a]pyrene above the MCL in areas outside the current DNAPL "footprint." In most cases, they are immediately outside the footprint or only marginally above the MCL (0.24 micrograms per liter in BH-29A, compared with the MCL of 0.2 micrograms per liter).*	The EPA's inference is flawed. The groundwater model assumptions that lead to over-predictions of plume size do not necessarily over-predict restoration time frame. Leaching from the solidified block would create a 'halo' (acknowledged by the EPA in the subsequent paragraph) that would remain in perpetuity and not be 'flushed out' as indicated by the EPA. Also, as the EPA acknowledges, benzo[a]pyrene is present in groundwater above MCLs outside the area of DNAPL. Benzo[a]pyrene is also present in soil outside the area of DNAPL at concentrations that leach to groundwater resulting in concentrations above MCLs. Because of the recalcitrant nature of benzo[a]pyrene, concentrations above MCLs would persist very long after source treatment. See also PRP Response No. 37 to Page ES-13, *Compliance with the MCL ARAR* above.	In the December 3, 2014 meeting, EPA committed to review this comment again. Upon further review, the Respondents may delete the cited text.	Text has been deleted.

REVIEW COMMENTS AND RESPONSES

Draft Final Feasibility Study, Quendall Terminals Site,

RESPONDENTS' RESPONSE DATE: November, 06 2015

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
44b	*Section 7.1.1.2* *Residuals from in situ solidification.*	*It is expected that there will be a "halo" around the solidified area(s). The mobile benzene and naphthalene that leaches from the block(s) will be undergo degradation and will be dispersed and diluted in the groundwater. Because benzo(a)pyrene is essentially immobile, it will not likely leach from the block(s) or leach only a de minimis amount. EPA does not considered the solidified block as aquifer material; however the model assumes no change in groundwater concentrations in the block as a result of the solidification. This assumption most likely yields greatly over-stated initial post-remediation COC concentrations within the solidified areas and therefore greatly over-stated mass flux estimates that contribute to downgradient MCL exceedances and longer restoration timeframes.*	While the solidified block may not be considered by the EPA as "aquifer material", it nonetheless is saturated with contaminated porewater in contact with DNAPL. The groundwater model correctly reflects this condition. The EPA does not provide any explanation as to why or authority to support its statement that groundwater in intimate contact with DNAPL within the solidified block would have lower COC concentrations than present groundwater conditions.	In the December 3, 2014 meeting, EPA committed to review this comment again. The Respondents may remove the portion of the text that states: *"EPA does not considered the solidified block as aquifer material; however the model assumes no change in groundwater concentrations in the block as a result of the solidification. This assumption most likely yields greatly over-stated initial post-remediation COC concentrations within the solidified areas and therefore greatly over-stated mass flux estimates that contribute to downgradient MCL exceedances and longer restoration timeframes."*	Indicated portion of text has been removed in accordance with EPA's July 2015 response. In addition, 'de minimis' has been revised to 'small'.
45	*Section 7.1.1.2* *Residuals from potentially not addressing every occurrence of DNAPL.*	• *Although the lateral and vertical extent of PTW remediation in both the upland and aquatic areas of the Site will be based on a field performance standard (to be determined during remedial design), small volumes and masses of DNAPL residuals could be inadvertently missed during remedy implementation. DNAPL residuals would most likely be in very thin laterally discontinuous sand stringers within the Shallow Aquifer bounded by relatively impermeable silts/clay making them very low strength groundwater contamination sources. Naphthalene and benzene mass and thus groundwater concentrations would decay over time based on their half-lives. Benzo(a)pyrene would essentially not decay and would remain essentially immobile and not significantly contribute to dissolved groundwater contamination.* *It is expected that best management practices would be used during remedy construction to address these issues related to residuals.*	Given the complex distribution of DNAPL at the Site, we agree that it is highly likely that DNAPL residuals will result under any alternative. While we believe that portions of the DNAPL source can be reliably contained, even small amounts of DNAPL remaining will persist and contribute to localized groundwater contamination in perpetuity. EPA states that it expects that BMPs will address these occurrences but provides no information on the BMPs to be used or to what degree they would address residuals. Regardless of the BMPs used during the remedy, residuals will remain and will be a source to contamination to groundwater in perpetuity.	In the December 3, 2014 meeting, EPA committed to review this comment again. Upon further review, the Respondents may remove the portion of the bullet that says: *"Naphthalene and benzene mass and thus groundwater concentrations would decay over time based on their half-lives. Benzo(a)pyrene would essentially not decay and would remain essentially immobile and not significantly contribute to dissolved groundwater contamination."* The last sentence about BMPs (after the bullet) may also be revised to: *"It is expected that issues related to residuals will be addressed during remedial design, treatability testing, and*	Clarification has been added that residuals will be managed during remedial design, etc. and that residuals are expected to remain regardless of BMPs implemented.

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
				remedial construction, in order to adequately characterize the nature and extent of DNAPL and maximize the effectiveness of removal and/or treatment technologies ."	
46	*Section 7.3.3.2 Adequacy and Reliability of Controls*	***RCM Caps.*** *The adequacy and reliability of RCM caps is difficult to predict because the technology is relatively new. There is little field information about long-term effectiveness and reliability of RCM caps. There is no field information about how RCM placement and replacement/repair may affect the long-term viability of the RCM caps. The lack of long-term field experience and the need for treatability/pilot studies is a significant concern about the reliability of a technology that will be required in perpetuity. There is considerable debris on and in the surface sediments at Quendall that may cause problems with RCM integrity unless the sediment is sufficiently cleared of debris. The shoreline bathymetry would be required to be maintained, which may limit repair and replacement options. RCM caps may lose their effectiveness when the reactive material becomes saturated or damaged.*	See PRP Response Nos. 7 and 16 to EPA Comment Items 3.a.iii and 12.	See EPA's response to PRP Response Nos. 7 and 16. Respondents may revise discussion of RCM caps in Section 7.3.3.2 in the context that RCM caps could still be used for alternatives that proposed them for T-Dock sediment. As noted earlier, amended sand caps will be included for alternatives that proposed RCMs in the nearshore area. EPA will review revisions prior to finalizing the FS.	See response to EPA comment #3.a.iii
47	*Section 7.3.6.1 Technical Feasibility*	*There is little field experience with the general use of RCM caps and especially, there is no field information/experience regarding the long-term use and long-term efficacy of RCM caps. There is no information about the expected longevity of RCM caps nor is there much experience with repairing/replacing RCMs when they become ineffective. Unusual technical challenges are expected when RCM caps are placed and repaired or replaced in the aquatic environment because they have only been in use for a short period of time*	See PRP Response Nos. 7 and 16 to EPA Comment Items 3.a.iii and 12.	See EPA's response to PRP Response Nos. 7 and 16. Respondents may revise discussion of RCM caps in Section 7.3.6.1 in the context that RCM caps could still be used for alternatives that proposed them for T-Dock sediment. EPA will review revisions prior to finalizing the FS.	See response to EPA comment #3.a.iii
48	*Section 7, General*	Balancing Criteria Ratings	We disagree with the rating of alternatives that the EPA has assigned for the following NCP criteria: 'Low' for Long-Term Effectiveness of Alternatives 4 and 4a.	EPA has reviewed the Respondents' rationale for proposed ranking changes and agrees to the following: 'Low' for Long-Term Effectiveness of Alternatives 4 and 4a.	Ranking changes have been made in accordance with EPA's July 2015 responses.

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
			'Low' for Implementability of Alternative 3. 'Moderate' for Short-term effectiveness and Implementability of Alternative 4a. 'Moderate' for short-term effectiveness of Alternative 7. 'High' for implementability of Alternative 7.	*EPA accepts the proposed change from 'low' to 'moderate' for these alternatives, given the change from RCM caps to amended sand caps in the nearshore.* 'Low' for Implementability of Alternative 3. *EPA will accept a change from 'low' to '<u>moderate</u>' (not 'low' to 'high' as proposed) based on the rationale given, particularly with the change from RCM caps to amended sand caps in the nearshore.* 'Moderate' for Short-term effectiveness and Implementability of Alternative 4a. *EPA accepts the proposed change from 'moderate' to 'high' for rating.* 'Moderate' for short-term effectiveness of Alternative 7. *EPA rejects the proposed change from 'moderate' to 'low' for this rating. While the in-water construction activities for Alternative 7 are more extensive than Alternative 6, the upland activities are similar. Alternatives 8 through 10 include similar to more extensive in-water work, as well as more extensive upland construction, and should be distinguished as rating lower than Alternative 7.* 'High' for implementability of Alternative 7.	

PRP Response No.[1]	SECT/PARA	EPA COMMENT	PRP ISSUE/RESPONSE (NOVEMBER 2014)	EPA FOLLOW-UP RESPONSE (JULY 2015)	PRP ISSUE/RESPONSE (NOVEMBER 2015)
				EPA accepts the proposed change from 'high' to 'moderate' for this rating.	

ATTACHMENT F

Remedy Selection. Letter to Mr.

James Wolford, EPA, March 19, 2018

March 19, 2018

VIA ELECTRONIC MAIL

Mr. James Woolford, Director
Office of Superfund Remediation and Technology Innovation
Office of Land and Emergency Management
U.S. Environmental Protection Agency
Washington, D.C.
Woolford.James@epa.gov

Re: Quendall Terminals – Remedy Selection

Dear Mr. Woolford:

We appreciate you and your staff's willingness to participate in a call with us in January to discuss the U.S. Environmental Protection Agency's ("EPA's") Task Force Recommendations and how they may help to facilitate the redevelopment of Quendall Terminals. We understand you and/or others at EPA Headquarters will be involved in the remedy selection at Quendall, particularly because the cost of the expected preferred remedy will exceed $80 million.[1] The preferred remedy selection and costs are driven in large part by Region 10's interpretation of various agency policies. We want to make sure you and other at Headquarters are aware of the concerns we have expressed to Region 10 concerning how its policy interpretation is impacting remedy selection.

As we discussed in January, the Quendall Site is primed for redevelopment. The Site has an approved master plan that incorporates public use (parks and waterfront trails) and mixed commercial development that will benefit the local economy. This is exactly the type of redevelopment the Task Force intended to facilitate through its Recommendations, and we were encouraged when EPA placed the Quendall Site on its list of sites targeted for immediate and intense action. However, as we discussed in January, it does not appear that any of the Task Force Recommendations are being implemented at Quendall Terminals. On the contrary, it appears the remedy selection process is continuing in a manner that is inconsistent with the Task Force Recommendations and existing EPA policy. We hope that Headquarters' continued involvement in the remedy selection process will result in changes that will allow the Quendall redevelopment to occur.

This letter provides you with a summary of the key elements that should be considered as EPA develops the Proposed Plan:

- **Principal threat waste (PTW) should be redefined consistent with EPA policy.** Region 10 has broadly defined principal threat waste (PTW) as all creosote- and coal tar-impacted

[1] EPA has indicated that the remedy selected in the Proposed Plan will be very similar to Alternative 7 of the Feasibility Study (Aspect 2017), which calls for *in situ* solidification of approximately 240,000 cubic yards of soil and dredging/off-site disposal of approximately 70,000 cubic yards of lake sediments. EPA is also evaluating the potential to supplement *in situ* solidification with thermal treatment using the STAR technology.

materials, regardless of their potential mobility and risk of exposure. This is inconsistent with EPA policy and leads to a much more aggressive remedy than is warranted. Redefining PTW to reflect site-specific considerations of hazard and risk would allow the remedy to more efficiently achieve cleanup goals.

- **Groundwater should be reclassified as a nondrinking water source.** Groundwater is not used as a source for drinking water and is not anticipated to be used in the future, due to local regulations and area water supply sources. Reclassification of the aquifers to reflect groundwater use would allow more achievable remedial goals and a more practicable remedy.

- **Region 10's proposed remedy would impose an onerous burden on redevelopment activities and would not expedite cleanup and reuse**. The cost and time frame of Region 10's proposed remedy makes redevelopment less feasible. The proposed remedy would require solidification of 240,000 cubic yards of soil and dredging of 70,000 cubic yards of sediment over a 6-year time frame. The cost is projected to far exceed the value of the property and the resources of the property owners. The cost and duration would be further exacerbated if Region 10 proceeds with its plan to integrate STAR, an experimental thermal technology poorly suited to Quendall Site geology, into the remedy.

These considerations are further discussed below.

PTW Classification at Quendall is Inconsistent with EPA Policy

EPA Region 10 has applied an overly conservative definition of PTW that is inconsistent with EPA guidance and EPA's decisions at other sites.

The Concepts of Hazard and Risk Must be Considered When Defining PTW. In accordance with the National Contingency Plan (NCP) and EPA guidance ('A Guide to Principal and Low-Level Threat Wastes, EPA 1991), materials that are considered PTW include those that are highly mobile or highly toxic and cannot be contained in a reliable manner. At the Quendall Site, EPA has defined PTW as all soils and sediments impacted by coal tar and creosote, regardless of the potential risk these materials pose. For example, EPA's definition of PTW at the Quendall Site includes thin layers of non-mobile product-coated soil and sediments at any depth, regardless of future exposure risk or the accessibility of those layers for treatment. In addition:

- The vast majority of material removed or solidified by the proposed cleanup will be relatively clean overburden soils and sediments that are not source materials. Of the 310,000 cubic yards of materials planned for solidification or removal, only 36,000 cubic yards (12 percent) contain creosote or coal-tar product.

- Of the 36,000 cubic yards of soil and sediment containing product, only 9,900 cubic yards—or 3 percent of the total volume slated for solidification—were classified as oil-wetted materials (i.e., contain potentially mobile product). The remaining 26,100 cubic yards comprise non-mobile product-coated soil and sediment.

<u>Application of PTW Policy at Quendall Is Not Consistent with Other Superfund Sites.</u> Consistent with EPA guidance, the identification of source material as principal or low-level threat waste involves the concepts of both hazard and risk and is determined on a site-specific basis to help streamline the remedy selection process, not as a mandatory waste classification requirement (EPA 1991). At numerous other Superfund sites, EPA has not defined creosote or coal-tar materials as PTW or has defined PTW materials more narrowly than at the Quendall Site. For example, in the Quanta Resources Superfund Site (Quanta) Proposed Plan (EPA, July 2010), only a portion of soils containing product—specifically, areas containing the greatest mass of free phase[2] (i.e., potentially mobile) product—were designated PTW. Other contaminated materials at Quanta, including soils containing residual NAPL without free phase product, or deep occurrences of free-phase product, were classified as low-level threat wastes and were not slated for treatment or removal. Similarly, in the Camilla Wood Treatment Company Superfund Site ROD (EPA, September 2009), the only material classified as PTW was free-floating product in two monitoring wells, a small subset of all contaminated materials at that site.

<u>The NCP Provides Flexibility in Addressing PTW.</u> Additionally, the NCP and EPA guidance provide flexibility to address source materials by means other than aggressive treatment. EPA guidance (Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites, EPA 2012) notes that there are situations where, "based on the balancing of trade-offs among alternatives", it "may be appropriate under certain circumstances" to employ institutional controls (ICs) that prevent or limit exposure to source materials as part of the site remedy and that the use of ICs in these situations is "consistent with the NCP." For example, in the Picayune Wood Treating Site ROD (EPA 2007), EPA stated:

> *"Because of the high cost, excavation and treatment of all principal threat wastes to satisfy the expectation established in the NCP is not a realistic alternative. Further, since other less expensive means exist (e.g., the selected remedy) to isolate the waste and thus protect public health, the treatment expectation cannot be reasonably justified."*

<u>Most of What is Classified as PTW at Quendall is Not Highly Mobile or Highly Toxic.</u> The majority of contamination at the Quendall Site does not represent a significant risk to human health or the environment. In fact, EPA found that all of the alternatives evaluated in the Feasibility Study (other than No Action) were protective of human health and the environment, even those that relied upon containment strategies alone. In particular:

- Much of the product at the Quendall Site is located in thin layers or stringers within a low-permeability soil matrix, precluding future migration.
- Groundwater data presented in the RI shows that the mass flux of leached constituents is balanced by the rate of natural degradation and that upland source materials do not impact surface water.

---

[2] At the Quendall Site, soils containing 'free-phase' product are termed 'oil-wetted', whereas materials containing residual NAPL are termed 'oil-coated'.

- Future development would include conventional and reliable engineering and institutional controls preventing direct contact with contamination.

In short, there is no justification for designating all product-containing materials as PTW at the Quendall Site or requiring aggressive treatment of all of these materials. Doing so advances a remedy that is not practicable to implement and is a barrier to beneficial reuse of the Site.

Groundwater Should be Reclassified as a Nondrinking Water Source

The Superfund Task Force Recommendations included the following:

> *"For aquifers not reasonably anticipated for drinking water use in the near- or long-term, consider modifying how groundwater use designation is determined for these aquifers."*

As described in the RI Report (Aspect and AnchorQEA 2012), groundwater at the Quendall Site is not a current or likely future source of drinking water. It is within an area of municipal water supply that is sourced from outside the area, and installation of domestic wells in the area is prohibited by local codes.

Remedial Action Objective HH1 for Quendall is "to restore groundwater to its highest beneficial use (drinking water) by meeting COC MCLs in the Shallow and Deep Alluvium Aquifers within a reasonable time." However, none of the alternatives in the FS are anticipated to achieve this goal. Reclassifying groundwater at the Quendall Site would result in goals that are more realistically tied to actual anticipated groundwater use and a more implementable remedy.

EPA's Remedy is Inconsistent with Expediting Site Redevelopment

EPA Region 10's preferred remedy would hamper redevelopment by incurring unnecessary time and expense in conducting the cleanup. In particular:

- EPA's preferred remedy is estimated to cost in excess of $80 million. This far exceeds the value of the land. No developer will purchase the property if the cleanup burden exceeds the property value.

- The remedy includes solidifying approximately 240,000 cubic yards of soil with cement, which increases soil volume and will raise the grade across much of the site approximately 2 to 3 feet. Installing subgrade features, including utility corridors and foundations, will require removal of solidified contaminated soil, resulting in substantial additional costs and further reducing the economic viability of the project.

- The estimated time for implementation of EPA's preferred remedy, based on the Feasibility Study, is 6 years. This time frame reduces the interest of developers who are less likely to take on projects with such a protracted return on investment.

- Region 10 is proposing to supplement upland solidification with STAR, an experimental *in situ* thermal remedy. STAR is poorly suited to the Quendall Site characteristics and is likely to only increase remedy cost while providing less effective treatment than solidification.

Furthermore, the time required to pilot test, collect pre-design data, design, and implement an experimental technology, in addition to solidification, would further delay construction.

- The enormous scale of the remedy will likely be resisted by adjacent property owners and the community due to significant and extended impacts, likely leading to delayed finalization of the ROD and implementation of the remedy. We believe that Region 10 has not adequately considered the environmental and community impacts of its preferred remedy.

These factors make it highly unlikely that the remedy could be implemented within the development time frame of the property and endanger the mandate for "immediate and intense action" at the Quendall Site.

Conclusions

EPA's proposed remedy for the Quendall Site is contrary to the objectives of the Superfund Task Force Recommendations. It will not advance efficient and timely cleanup or reuse of the Site, but instead places an unnecessary burden on redevelopment with no tangible benefit to protection of human health or the environment. We encourage EPA to use the flexibility inherent in the regulations to choose a remedy that meets both the NCP requirements and advances the Quendall Site to cleanup and development in accordance with the Superfund Task Force Recommendations.

During our call in January, you indicated that you would be evaluating the potential for implementing some of the Task Force Recommendations at Quendall and would be discussing the potential impact of the use of STAR with Region 10. We would like to schedule a call to get an update on these issues and to better understand how Headquarters intends to help facilitate redevelopment at Quendall Terminals.

Sincerely,

Robert Cugini

Robert Cugini

cc: Sheryl Bilbrey
Chris Hladick
Ted Yackulic
Georgia Baxter

ATTACHMENT G

Quendall Terminals – STAR Pilot Study and Proposed Plan. Letter to Cami Grandinetti, EPA, dated November 14, 2018

November14, 2018

VIA ELECTRONIC MAIL

Cami Grandinetti
EPA Region 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

Re: Quendall Terminals – STAR Pilot Study and Proposed Plan

Dear Cami,

We appreciate Region 10 sending us a copy of the Savron STAR pilot study report and understand EPA is evaluating whether to utilize the STAR technology as part of the proposed plan for Quendall Terminals (Site) in Renton, Washington. We are very surprised, based on the pilot study results and feedback from potential developers, that EPA is still considering STAR as a component of the Quendall Terminals remedy. As we have noted in the past, the use of STAR adds cost, effectiveness, and schedule uncertainties to the remedy that are unacceptable to a potential developer. The pilot study results clearly indicate that the STAR technology will not achieve remedial action objectives previously identified by EPA. The data also indicate that if it were implemented, the costs would be substantially higher than suggested by the vendor's full-scale implementation plan.

The STAR pilot study demonstrated the following:

- Contaminant concentrations over a majority of the Site will not support self-sustaining combustion;
- Post-treatment concentrations exceed EPA's remedial action objectives for the Site;
- The pilot study did not determine key parameters needed for evaluating the effectiveness and cost of implementing STAR at the Site;
- The design assumptions for full-scale implementation at the Site are deeply flawed, as they were not consistent with findings in the pilot study report; and
- The inclusion of STAR in the Proposed Plan at this late point, without rigorous evaluation through the Feasibility Study (FS) process, is inappropriate.

These points are discussed further below.

Contaminant concentrations over a majority of the DNAPL area will not support self-sustaining combustion. Similar to the bench study, which only had a 50 percent success rate, the pilot study only achieved the fundamental goal of self-sustaining ignition at one of two

Anchorage
Bellevue
Los Angeles
New York
Portland
San Francisco
Seattle
Shanghai
Washington, D.C.
www.dwt.com

tested locations. Although the vendor attributed the failure to an equipment failure, they also acknowledged that the failure to sustain combustion after 44 hours of heating was likely due to the lower concentrations of TPH present at the IP-2 well screen (up to 3,500 mg/kg) (Savron 2018b p. 9). However, these "lower concentrations of TPH" are not unique to the IP-2 well screen; they are found throughout the characterized DNAPL areas, including the pilot study area. The vendor provides a minimum range of 3,000 to 5,000 mg/kg TPH to sustain combustion (Savron 2018b p.16), and the poor performance at IP-2 suggest that the lower portion of this range is not adequate. Of the pre-STAR samples in the treatment zone of the pilot study area, less than half (10 of 25) exceeded the 5,000 mg/kg threshold. In two DNAPL areas further investigated during the pilot study, only one had a majority of TPH concentrations high enough to sustain combustion. These observations match with the 50 percent "success" rate of the pilot study and the 50 percent "success" rate of the bench study. We are surprised that EPA might consider a 50 percent success rate adequate.

Post-treatment concentrations exceed EPA's remedial action objectives for the Site. Throughout the remedy selection process, EPA has insisted that the selected remedy fully treat all Principal Threat Waste (defined as DNAPL-containing material). In the bench study, EPA established treatment goals based on EPA's Regional Screening Levels Protective of Groundwater (Savron 2018a). The results of the pilot study indicate that STAR cannot achieve either of these objectives. In particular:

- As discussed above, much of the DNAPL area does not contain concentrations supportive of self-sustaining combustion. The vendor acknowledges that the technology is not likely applicable to these areas, including the QP-1 investigation area and "fringe areas". Even within areas exhibiting higher DNAPL concentrations, there is substantial spatial variability, indicating that there is a high likelihood that pockets of DNAPL will not be treated, or will be only partially treated (Savron, 2018b, p.23).
- After treatment, layers of product were observed at four (PT-3, PT-6, PT-8, and PT-10) of the nine post-STAR borings that are located within the estimated radius-of-influence from the ignition point. That layers of product were still visible post-treatment indicates treatment objectives were not reached in these areas.
- Even within the area of "treatment", the measured concentrations greatly exceed both Site Preliminary Remediation Goals (PRGs) and the bench study treatment goals, as shown in the attached Table 1. In particular, naphthalene concentrations within 2 feet of the ignition point remained at concentrations up to 110 mg/kg (PT-02-11). For comparison, the Site PRG is 3.8 mg/kg, and the bench study treatment goal was 0.05 mg/kg.

The pilot study did not determine key parameters needed for evaluating the effectiveness and cost of implementing STAR at the Site. A number of objectives of the pilot study were not met. For example:

- Inadequate vapor recovery occurred (Savron 2018b p.10) due to the lack of a surface cap, which prevented both a proper evaluation of contaminant mass destroyed versus volatilized and a clear estimation of off-gas treatment costs. The vendor estimated the mass volatilized based on the collected vapor data; however, as they acknowledge that limited capture was achieved, this estimate is likely highly inaccurate.
- Temperature readings indicated a very small area of influence, with combustion temperatures only detected within 2 feet of the ignition point. The vendor attributed the lack of better temperature data to heterogeneity and estimated the area-of-influence based on measured concentration reductions and visual observations but, as noted above, concentration reductions were incomplete and variable. This has an enormous effect on full-scale implementation; the vendor's estimate of 2,740 ignition points with a 7-foot radius of influence would increase to 5,370 points for a 5-foot radius of influence and 33,565 points for a 2-foot radius of influence.

The design assumptions for full-scale implementation at the Site are deeply flawed. The assumptions used in developing the full-scale treatment approach are not consistent with the findings and recommendations within the report. In particular:

- The full-scale design proposes treating the entire region of upland DNAPL. However, as discussed above, a significant portion of this area does not have sufficient DNAPL mass or concentration to support self-sustaining combustion.
- The full-scale design assumes "the entire thickness of impacts can be treated from an IP installed at a single depth." This is clearly a false assumption, as proven by the monitoring data within the pilot area (where layers of product remained after treatment) and by the vendor's own analysis of the MC-1 area (Savron, 2018b, p.19). The proposed full-scale implementation does not account for the need for multi-depth installations or describe how such installations affect the implementation, performance, and treatment time for the remedy, except to say that it would result in increased costs (Savron 2018b, p.21).
- The vendor's strategy is to design to treat the entire Site at one depth and "adjust during operations to account for Site uncertainty". There is no discussion about the sensitivity in cost or remediation time that may occur from this approach, but the variability in the final system is potentially enormous. The vendor's estimate for a single-depth ignition-point network is operation of 2,270 ignition points over 2.5 years. Based on the layering at the Site, two, three, or even more, layers of ignition points may be needed at many locations. Factoring these in with other uncertainties--such as area of influence discussed above--the proposed adaptive design approach could result in <u>order-of-magnitude</u> uncertainties in time and cost, which is not an appropriate level of accuracy for decision making. No developer is going to sign up for a remedy that involves the enormous uncertainties in the effectiveness, cost, and time to implement STAR.

The inclusion of STAR in the Proposed Plan at this late point, without rigorous evaluation through the FS process, is inappropriate. Alternatives including STAR were not evaluated as part of the feasibility study. Selection of STAR as a remedy component should consider carefully the benefits and disadvantages of the technology at the same level of rigor as applied in the FS. No cost estimates were included with the full-scale treatment approach; based on the uncertainties in design, such as the assumption of a single-depth point application, we are doubtful a cost estimate at an FS-level of accuracy (-30/+50%) can be developed. The experimental status of this technology leads to many questions on its effectiveness, permanence, short-term impacts, and cost that were not answered by the pilot test. Introducing such uncertainties will deter timely Site cleanup and redevelopment.

We appreciate your consideration of these comments.

Sincerely,

Robert Cugini

Robert Cugini

Enclosure

cc: Steven Cook
Sheryl Bilbrey
Ted Yackulic
Georgia Baxter
Lynn Manolopoulos
Jim Benedict

Table 1 - Comparison of Post-Treatment Soil Sampling Results to Quendall Terminals PRGs and Pilot Study Treatment Goals

Analyte[2]	PRG[3]	Pilot Study Treatment Goal[4]	Post-Treatment Soil Sampling Results Inside Treatment Zone[5]	
			Average[6]	Maximum
Total Petroleum Hydrocarbons				
Gasoline-Range Organics	--	100	**204**	**1,000**
Diesel-Range Organics	--	2,000	445	1,400
Motor Oil-Range Organics	--	2,000	57.1	75
Polycyclic Aromatic Hydrocarbons				
2-Chloronaphthalene	--	3.9	0.0393	<0.2
2-Methylnaphthalene	240	0.185	**9.50**	**56**
Acenaphthene	--	5.5	**5.60**	**22**
Anthracene	--	58	2.73	9.2
Benzo(a)anthracene	0.16	0.05	**5.24**	**36**
Benzo(a)pyrene	0.016	0.235	**6.43**	**44**
Benzo(b)fluoranthene	0.16	0.3	**12.6**	**90**
Benzo(k)fluoranthene	1.6	2.9	**4.45**	**34**
Chrysene	16	9.1	8.37	**62**
Dibenzo(a,h)anthracene	0.016	0.096	**1.79**	**10**
Fluoranthene	--	89	8.98	46
Fluorene	--	5.5	3.69	**14**
Indeno(1,2,3-cd)pyrene	0.16	0.98	**5.01**	**32**
Naphthalene	3.8	0.05	**32.5**	**110**
Pyrene	1,800	13	7.97	**38**
BTEX				
Ethylbenzene	5.8	--	0.430	2

PRG Preliminary Remediation Goal

Notes:

1) All concentrations are in milligrams per kilogram (mg/kg).

2) Only analytes for which a PRG and/or a pilot study treatment goal have been established are included in this table.

3) PRGs are based on human health risk assessment, as summarized in Table 4-8 of the *Quendall Terminals Feasibility Study* (Aspect, 2016).

4) The pilot study treatment goals are the *Lowest Project Criterion* listed in Table 2-3 of the *Quality Assurance Project Plan* (CH2M, 2018).

5) Analytical results for the twelve post-treatment soil samples are summarized in Table 4 of *Self-sustaining Treatment for Active Remediation (STAR) Pre-Design Evaluation (PDE) Report* (Savron, 2018). Shaded values exceed the PRG. Bolded values exceed the pilot study treatment goal.

6) In calculating the average concentrations, undetected analytes were assumed to be present at one-half the detection limit.